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# ***JPRS Report***

## **Science & Technology**

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***USSR: Electronics &  
Electrical Engineering***

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# Science & Technology

## USSR: Electronics & Electrical Engineering

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### CONTENTS

26 March 1991

#### Broadcasting, Consumer Electronics

Use of Paraboloid Reflectors With Cellular Macrostructure in Motion Picture Lighting Equipment <i>[N. T. Semenikhin; TEKHNIKA KINO I TELEVIDENIYA, No 12, Dec 90]</i> .....	1
Multistandard Decoder of Color Information <i>[V. N. Kupriyanenko, A. M. Mynrikov, et al.; TEKHNIKA KINO I TELEVIDENIYA, No 12, Dec 90]</i> ..	1
Problems of Monitoring and Measurement in Today's Television <i>[L. S. Vilenchik, Yu. A. Medvedev; TEKHNIKA KINO I TELEVIDENIYA, No 12, Dec 90]</i> .....	1
HDTV Digital Signal Coders and Decoders For Fiber Optic Line Transmission <i>[E. B. Makhmudov; TEKHNIKA KINO I TELEVIDENIYA, No 12, Dec 90]</i> .....	1
Cable Television: Managing New Developments <i>[A. Barsukov; TEKHNIKA KINO I TELEVIDENIYA, No 12, Dec 90]</i> .....	2
SSTV: Slow Scan Television <i>[Ye. Sukhovertov; RADIO, No 12, Dec 90]</i> .....	2
Modular Individual Receiver Unit <i>[S. Sotnikov; RADIO, No 12, Dec 90]</i> .....	2
'Orion-128': Early Results <i>[V. Sugonyako, V. Safronov; RADIO, No 12, Dec 90]</i> .....	2
SVP-403 Touch Channel Selector <i>[A. Potapov; RADIO, No 12, Dec 90]</i> .....	2
New Designs and Development Outlook For Glow Discharge Starters <i>[V. Ye. Demyshev, A. M. Kokinov, et al.; SVETOTEKHNIKA, No 12, Dec 90]</i> .....	3
Fluorescent Concentrators As Optical Color Elements of Lighting Devices <i>[V. K. Baranov; SVETOTEKHNIKA, No 12, Dec 90]</i> .....	3
Evaporative Cooling of Light Sources <i>[A. V. Atamas; SVETOTEKHNIKA, No 12, Dec 90]</i> .....	3
Improving Fluorescent Lamps By Using Getter Technology <i>[N. I. Churkina; SVETOTEKHNIKA, No 12, Dec 90]</i> .....	3
On Calculating Production Volume of General-Purpose Incandescent Lamps According to Their Voltage Range <i>[A. M. Kokinov, P. G. Chernikov; SVETOTEKHNIKA, No 12, Dec 90]</i> .....	4
On Using Secondary Resources <i>[V. P. Shapurin; SVETOTEKHNIKA, No 12, Dec 90]</i> .....	4
Lighting Engineering Group From 'Krasnyy Oktyabr' Plant <i>[S. A. Tikhun; SVETOTEKHNIKA, No 12, Dec 90]</i> .....	4
On the State of Lighting Engineering in the Peoples Republic of China <i>[A. Ye. Atayev, V. V. Belov, et al.; SVETOTEKHNIKA, No 12, Dec 90]</i> .....	4
Examinations of Metrological Characteristics of Chromatometers <i>[V. A. Solov'yev; SVETOTEKHNIKA, No 11, Nov 90]</i> .....	5
Efficient Daylight Utilization in Transportation Buildings <i>[A. M. Godin, N. P. Pinskaya, et al.; SVETOTEKHNIKA, No 11, Nov 90]</i> .....	5
Lighting and Signal Equipment For Heliports: A Review <i>[Yu. G. Basov; SVETOTEKHNIKA, No 11, Nov 90]</i> .....	5
Cable Television Network Simulator <i>[V. K. Marigodov, V. B. Novozhilov, et al.; TEKHNIKA KINO I TELEVIDENIYA, No 11, Nov 90]</i> .....	5
Underwater Television Systems Exhibited at 'Inrybeprom-90' <i>[Ya. L. Butovskiy; TEKHNIKA KINO I TELEVIDENIYA, No 11, Nov 90]</i> .....	6
Cable Television: A Missed Opportunity <i>[A. Altayskiy; TEKHNIKA KINO I TELEVIDENIYA, No 11, Nov 90]</i> .....	6
Open Cinematography System and High Definition Television <i>[S. G. Muchiev; TEKHNIKA KINO I TELEVIDENIYA, No 10, Oct 90]</i> .....	6
Test Films For Television <i>[Ye. L. Nelskiy, T. N. Novikova, et al.; TEKHNIKA KINO I TELEVIDENIYA, No 10, Oct 90]</i> .....	6
The Limits of Depth Resolution in Stereo Television Systems <i>[V. Ye. Dzhakoniya, S. E. Koganer; TEKHNIKA KINO I TELEVIDENIYA, No 10, Oct 90]</i> .....	7
Cable Television: The Practice of Contractual Agreements <i>[A. Altaiskiy; TEKHNIKA KINO I TELEVIDENIYA, No 10, Oct 90]</i> .....	7

## Circuits, Systems

On the Effect of Radially Layered Refractive Index Fluctuations on Short Wave OTH Propagation in Tropospheric Waveguides [K. V. Koshel; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 12, Dec 90]	8
Microwave Piezoelectric Transducer With Microstrip Excitation System [M. A. Grigoryev, V. V. Petrov, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 12, Dec 90]	8
Excitation of Open-Ended Conical Surface By Radial Electric Dipole [V. A. Doroshenko, V. G. Sologub (deceased); <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 12, Dec 90]	8
Transient Electromagnetic Fields in Dihedral Angle [V. V. Borisov; <i>Moscow RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 12, Dec 90]	8
Problems of Physical Control Theory [A. A. Krasovskiy; <i>AVTOMATIKA I TELEMEKHANIKA</i> , No 11, Nov 90]	9
On the Problem of Optimal Control Synthesis in Systems With Distributed Parameters [F. D. Bayramov, T. K. Sirazetdinov; <i>AVTOMATIKA I TELEMEKHANIKA</i> , No 11, Nov 90]	9
Analysis of Automatic Feedback Control System by the Averaging Method [A. V. Knyazev; <i>AVTOMATIKA I TELEMEKHANIKA</i> , No 11, Nov 90]	9
Functional Monitoring and State Correction of Moving Object Control Loop [A. B. Kuzmin; <i>AVTOMATIKA I TELEMEKHANIKA</i> , No 11, Nov 90]	9
Piecewise-Linear Deparallelizing of Program Loops With Linear Index Expressions [O. V. Lukinova; <i>AVTOMATIKA I TELEMEKHANIKA</i> , No 11, Nov 90]	10
Electrostatically Controlled Electronic Microwave Devices With Modulated Emission [V. A. Isayev, D. V. Sokolov, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	10
Radiator Synthesis Problem Allowing For Electromagnetic Compatibility Requirements [I. M. Polishchuk, I. G. Shvayko; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	10
Output Signal Simulator of Arrays Operating in Inhomogeneous Media [A. F. Maslov, K. P. Nesterov, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	10
On the Possibility of RF Phase Conjugation in Artificial Nonlinear Media [V. A. Kalinin, V. V. Shtykov; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	11
Dispersion Method of Detecting Determined Targets on Optical Texture and Radar Images of Earth's Surface [A. A. Potapov, T. V. Galkina, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	11
Pseudorandom PSK Signal Timing [V. I. Prytkov, G. I. Tuzov; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	11
Investigation of Relaxation Processes in GaAs Varicap-Tuned Microwave Oscillators [A. A. Usoltsev, V. G. Bozhkov; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	11
Relativistic Millimetric Band Diffraction Oscillator [S. P. Bugayev, A. N. Vlasov, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	12
Investigation of Space Charge Fields' Effect in O-Type Electron-Waveguide Systems With Relativistic Beams [N. L. Romashin; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	12
Two-Wave Laser Ranger-Refractometer [N. A. Armand, V. F. Bakhtiarov, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	12
Probability Distribution Estimates of Molecular Absorption in the Atmosphere of Radio Waves at Frequencies Above 10 GHz [V. N. Pozhidayev; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 11, Nov 90]	12
Nonmeasurable Parameter Estimation of Radio Electronic Circuits [S. K. Savin, V. I. Polivanov; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	13
Use of Nontraditional Antennas for Measuring Complex Dielectric Constant of Materials [S. Yu. Lapunov, A. V. Polonik; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	13
Precision Capabilities of Circular Tracks in Photoelectric Shaft Digitizers [V. G. Domrachev, F. A. Kostanyan, et al.; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	13
Effect of Atmospheric Precipitation on Errors of Phased Range Finders [I. P. Lukin; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	13
Determining Range Correction in Satellite Ranging [V. P. Nelyubina, N. F. Nelyubin; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	14
Oscillator Range Finder Applications of Integrating Optical Correlator [A. A. Vetrov, Yu. V. Popov; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	14
Pulse-Phase Solid State Laser Ranger [V. B. Volkonskiy, Yu. V. Popov, et al.; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	14

Systematic Errors of Optical Instrument Calibration in Remote Sensing [M. M. Mazur, V. N. Shorin; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	14
New Vacuum Gauge Calibration Technique [V. V. Kuzmin; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	15
Modulation-Based Method of Determining Channel Characteristics of Phased Antenna Array With Ferrite Phase Shifters [L. A. Letunov, G. Yu. Mosolov, et al.; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	15
Calibration of Reentry Vehicle Microaccelerometer Against Primary Standard [L. A. Savrov, K. N. Yunoshev, et al.; <i>IZMERITELNAYA TEKHNIKA</i> , No 11, Nov 90]	15
Dielectric Waveguide-Based EHF Devices: A Survey [S. V. Koshevaya, M. V. Kononov, et al.; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	15
Monolithic Dielectric Waveguide Microwave Devices: A Survey [B. Yu. Kapilevich, Ye. R. Trubekhin; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	16
Bandpass Expansion Limits of Slow-Wave Structures [S. V. Mukhin, V. A. Solntsev; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	16
Wide-Band Cophased Power Dividers With One Resistive Isolator [V. A. Sledkov, N. Yu. Savchenko; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	16
Physical Phenomena in Optically Controlled Silicon-Based Microwave Modulators Under Steady-State Conditions: Part 1 [O. G. Koshelev; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	16
Monolithic Dielectric Meter and Decimeter Band Filters [M. Ye. Ilchenko, G. A. Mirskikh, et al.; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	17
Frequency Response Analysis of Millimeter Band Transistorized Amplifiers [V. V. Muravyev, A. A. Tamelo, et al.; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	17
Varactor-Tuned Self-Biased Gunn Oscillator [P. A. Borodovskiy, A. F. Buldygin; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	17
Possibilities of Expanding Microwave Phase Shifter Bandwidth [B. V. Viktorov, V. V. Vorobyev, et al.; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	17
Tunable Microwave Phase Manipulator [A. V. Ulyanov; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	18
Steady-State Errors and Transient Process in Dual-Loop Phase Lock Systems of Long Microwave Line [G. P. Zemtsov, S. O. Plotnitskiy; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika</i> , Vol 33 No 10, Oct 90]	18
An Interference Grating [V. M. Osipenkov; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35, No 10, Oct 89]	18
Ferrite Rod Gratings and Their Application to Millimeter Waves [V. V. Merikuri, I. P. Nikitin, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 10, Oct 89]	18
An Optical Theorem for Receiving Antennas and its Consequences [G. A. Yerokhin; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 10, Oct 89]	19
Post-Detector Phase Detection of Weak Signals in Nongaussian Noise [V. S. Voshchenko, Ya. Yu. Nikitin, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 10, Oct 89]	19
Implementation of Microstrip Microwave Power Devices [V. A. Repin; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 10, Oct 89]	19
Calculation and Experimental Investigation of an Industrial Electron Gun [L. A. Neganova, V. A. Syrovoy, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 10, Oct 89]	19
Theoretical and Experimental Investigation of a New Type of Millimeter Band Frequency Converter [N. V. Budilovich, A. Ye. Yekzhanov, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 10, Oct 89]	20

Calculation of a Stationary Magnetic Resonance Signal in Optically Oriented Atoms Excited By an RF Pulse Sequence	20
[V. V. Semenov, N. F. Nikiforov, et al.; <i>RADIOTEKHNIKA I ELEKTRONIKA</i> , Vol 35 No 10, Oct 89]	20
Evaluating Synthetic Aperture Radar Resolution Through Noise Interference	20
[V. M. Shlyakhin; <i>RADIOTEKHNIKA</i> , No 10, Oct 90]	20
Analysis of Spatial Smoothing in Angular Signal Correlation Tasks	20
[A. B. Gershman, V. T. Yermolayev, et al.; <i>RADIOTEKHNIKA</i> , No 10, Oct 90]	20
Reversible Transformations of Random Processes With Fractional-Rational Spectral Density in Digital Analog Signal Processing Systems	21
[Ye. A. Smirnov; <i>RADIOTEKHNIKA</i> , No 10, Oct 90]	21
Analog Microwave Phase Shifters	21
[A. R. Tagilayev; <i>RADIOTEKHNIKA</i> , No 10, Oct 90]	21
Spatial Filtering Efficiency As a Function of the Number of Position of Interference Sources	21
[M. V. Ratynskiy; <i>RADIOTEKHNIKA</i> , No 10, Oct 90]	21
Analysis and Synthesis of Antenna Array With Sector-Shaped Partial Radiation Patterns	21
[S. P. Skobelev; <i>RADIOTEKHNIKA</i> , No 10, Oct 90]	21
Determining Electromagnetic Field Components on Uniform Earth Surface Excited By Aerial Wire	21
[V. F. Kalyuzhnyy; <i>RADIOTEKHNIKA</i> , No 10, Oct 90]	22
Adaptive Array Quality Criterion Allowing For External Noise Correlation	22
[A. I. Stashkevich, S. S. Shchesnyak; <i>RADIOTEKHNIKA</i> , No 10, Oct 90]	22
Piezoelectric Semiconductor Secondary Power Supply Source For Charging Capacitive Integrators	22
[S. G. Bochkarev, D. G. Voronin, et al.; <i>RADIOTEKHNIKA</i> , No 10, Oct 90]	22
A Comparison of Methods For Analyzing Electronic Circuit Dynamic Characteristics	22
[Yu. M. Gusarov, S. P. Losutnikov; <i>ELEKTRONNOYE MODELIROVANIYE</i> , Vol 12 No 5, Sep-Oct 90]	22
Methods of Recovering Diagnostic Information From Signatures	22
[O. N. Dyachenko, A. N. Tarasenko; <i>ELEKTRONNOYE MODELIROVANIE</i> , Vol 12 No 5, Sep-Oct 90]	22
Program For Evaluating Intersystem Power Transfer in the Main Network of an Interconnected Power System	23
[V. G. Derzskiy, I. G. Kudras, et al.; <i>ELEKTRONNOYE MODELIROVANIYE</i> , Vol 12 No 5, Sep-Oct 90]	23
Algorithm For Selecting a Method of Solving Linear Equations For Topological Modeling of Semiconductor Devices	23
[A. N. Bubennikov, A. V. Chernyaev; <i>ELEKTRONNOYE MODELIROVANIYE</i> , Vol 12 No 5, Sep-Oct 90]	23
Accuracy of Estimation of Target Position and Motion By Coherent Multiposition Instrument Systems Using Broadband Signals	23
[S. G. Nakhmanson; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA</i> , Vol 33 No 9, Sep 90]	23
Comparative Analysis of Scaling Methods in Signal Spatial Processors Using Fixed-Point Operations	23
[V. V. Zakharov; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA</i> , Vol 33 No 9, Sep 90]	23
Phase Adaptation Algorithm For Antenna Arrays of Arbitrary Geometry	24
[Yu. M. Shchapov; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA</i> , Vol 33 No 9, Sep 90]	24
Interference Suppression in a Single-Sideband Angle Modulation Signal Receiver	24
[M. M. Shakhmaev; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA</i> , Vol 33 No 9, Sep 90]	24
The Effect of Nonidentical Frequency Responses of Receive Circuits on the Effectiveness of Multichannel Digital Spatial Signal Selection Filters	24
[V. N. Manzhos, V. N. Kokin, et al.; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA</i> , Vol 33 No 9, Sep 90]	24
Partial Directional Pattern Control of a Waveguide Phased Array by Means of a Perforated Surface	24
[V. P. Kudin, N. I. Shlyk; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA</i> , Vol 33 No 9, Sep 90]	24

## Transportation

Interfacing Microprocessor-Controlled Railroad Systems With Outdoor Objects	25
[O. K. Dreyman, D. V. Gavzov, et al.; <i>AVTOMATIKA, TELEMEKHANIKA I SVYAZ</i> , No 12, Dec 90]	25
Optimization Criterial of Railroad Telegraph Communication Network	25
[I. P. Barbash, I. A. Zdrovitsov, et al.; <i>AVTOMATIKA, TELEMEKHANIKA I SVYAZ</i> , No 12, Dec 90]	25
Fault Location in Signaling, Interlocking, and Blocking Devices	25
[A. V. Grinenko, V. L. Labetskiy; <i>AVTOMATIKA, TELEMEKHANIKA I SVYAZ</i> , No 12, Dec 90]	25
Test Bench For Checking Signaling, Interlocking, and Blocking Devices	25
[A. Ya. Kushnarev, A. S. Malysh; <i>AVTOMATIKA, TELEMEKHANIKA I SVYAZ</i> , No 12, Dec 90]	25

Leningrad Cable System	26
[A. I. Kuzmin, A. P. Shcheglov; <i>ELEKTRICHESKIYE STANTSII</i> , No 12, Dec 90]	26
Certain Ways of Increasing the Development Efficiency of Soviet Power Industry Under New Economic Conditions	26
[N. F. Gorev; <i>ELEKTRICHESKIYE STANTSII</i> , No 12, Dec 90]	26
Power Industry in Regulated Market Economy: A Discussion	26
[M. N. Khodzhayev; <i>ELEKTRICHESKIYE STANTSII</i> , No 12, Dec 90]	26

## Computers

Modeling of Relations Within Small Groups and an Investigation of Negative Manifestations of the Human Factor in Management Processes	27
[Yu. M. Gorskiy; <i>ELEKTRONNOYE MODELIROVANIYE</i> , Vol 12 No 3, May-Jun 90]	27

## Power Engineering

Automatic Serviceability Check of Comprehensive Generator Protection	
[L. F. Borisov, V. N. Bochkarev, et al.; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA</i> , No 12, Dec 90]	28
Parameter Optimization of Oil-Filled Low-Pressure Cable Lines Using Complex Criterion	
[E. N. Zuyev, P. A. Merkulov; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA</i> , No 12, Dec 90]	28
Improving Commutator Mica Insulation	
[I. V. Kochugova; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA</i> , No 12, Dec 90]	28
Extraction of Intelligence Signals on Cable Line Fault Location Using Coaxial Differential Magnetic Transducers	
[V. V. Platonov, V. F. Bykadorov, et al.; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA</i> , No 11, Nov 90]	28
Microprocessor-Based Transducers For Power System Emergency Control Equipment	
[A.-S. S. Saukhatas [as transliterated]; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA</i> , No 11, Nov 90]	29
Digital Current Relays With Signal Waveform Recovery	
[E. V. Podgornyy, A. P. Malyy, et al.; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA</i> , No 11, Nov 90]	29
New Design of Two-Circuit Reinforced Concrete H-Frame Support	
[I. I. Chebotar, R. M. Sitdikov; <i>ENERGETICHESKOYE STROITELSTVO</i> , No 11, Nov 90]	29
Open Profile Piling Foundations For Installation in Permafrost Soil	
[J. P. Yermakov, S. I. Zanyatin, et al.; <i>ENERGETICHESKOYE STROITELSTVO</i> , No 11, Nov 90]	30
Future Outlook of Elektrobank	
[Ye. A. Minasbekov; <i>ENERGETICHESKOYE STROITELSTVO</i> , No 11, Nov 90]	30
Basic Issues of Electric Power Industry Control Under Economic Independence of Republics and Regions	
[Ye. Ye. Barykin, L. D. Khabachev, et al.; <i>ELEKTRICHESKIYE STANTSII</i> , No 11, Nov 90]	30
Principal Directions and Development Trends of Nuclear Power Plant Diagnostic Systems	
[A. I. Trofimov, A. K. Brovtsyn; <i>ELEKTRICHESKIYE STANTSII</i> , No 11, Nov 90]	30
Vacuum Furnace Deposition and Plating of Control and Stop Valve Parts	
[A. V. Orlov, Yu. N. Kriger, et al.; <i>ELEKTRICHESKIYE STANTSII</i> , No 11, Nov 90]	31
Economically Feasible Capital Investments in Wind Power Plants	
[V. S. Sharygin, A. V. Fomin; <i>ELEKTRICHESKIYE STANTSII</i> , No 11, Nov 90]	31
Development of Electric Motors and Generators With Reduced Vibration and Noise Levels	
[V. T. Medvedev, V. S. Malyshev, et al.; <i>ELEKTROTEKHNIKA</i> , No 11, Nov 90]	31
New Principles and Experience of Designing Industrial Power Supply Units	
[O. G. Bulatov, V. D. Polyakov, et al.; <i>ELEKTROTEKHNIKA</i> , No 11, Nov 90]	31
On the Possibility of Using Multiple-Winding Superconducting Magnetic Energy Storage Systems	
[V. V. Andrianov (deceased), A. Yu. Arkhangelskiy, et al.; <i>ELEKTROTEKHNIKA</i> , No 11, Nov 90]	32
Analyzing the Tasks of Improving Space Vehicle Electric Power Supply Systems	
[A. B. Tokarev; <i>ELEKTROTEKHNIKA</i> , No 11, Nov 90]	32
Hot-Molded Ceramic Materials in Electrical Engineering	
[A. N. Bibichev, A. V. Dolgov, et al.; <i>ELEKTROTEKHNIKA</i> , No 11, Nov 90]	32
Prospects for Heating Supplies in Kiev Through the Year 2000	
[O. P. Zelenyak, O. P. Zuev, et al.; <i>ENERGETIKA I ELEKTRIFIKATSIIA</i> , No 4, Oct-Dec 90]	33

Improving the Testing Reliability of Fuses [V. V. Kozyrskiy; ENERGETIKA I ELEKTRIFIKATSIYA, No 4, Oct-Dec 90]	33
Forecasting of Regional Power Production Capacity [Yu. G. Blavdzevich, S. K. Komova; ENERGETIKA I ELEKTRIFIKATSIYA, No 4, Oct-Dec 90]	33
Optimization of Energy Consumption by Industrial Enterprises [B. G. Tuvalbaev, Ye. M. Marchenko, et al.; ENERGETIKA I ELEKTRIFIKATSIYA, No 4, Oct-Dec 90]	33
The SPG-28-40 Solar-Powered Steam Generator in Experimental Operation [P. F. Zeytulaev; ENERGETIKA I ELEKTRIFIKATSIYA, No 4, Oct-Dec 90]	34
Training Cadres of Engineers and Scientists in Department of Electric Power at Moscow Institute of Energetics: Status and Problems [B. K. Maksimov; ELEKTRICHESKIYE STANTSII, No 10, Oct 90]	34
Hydraulic Engineers at Moscow Institute of Energetics Managing Nation's Energy Resources [V. I. Obrezkov; ELEKTRICHESKIYE STANTSII, No 10, Oct 90]	34
Impedance of Compensation in PDE-2003 Negative-Sequence Power Relay Protecting 330-750 kV Overhead Transmission Lines [V. A. Gitman, M. L. Zhidovetskiy; ELEKTRICHESKIYE STANTSII, No 10, Oct 90]	35
Transformer Oil Heater [N. K. Vasilyev, Yu. A. Fominykh, et al.; ELEKTRICHESKIYE STANTSII, No 10, Oct 90]	35
Wet-Discharge Characteristics of Hollow Cylindrical Insulators [G. N. Aleksandrov; ELEKTROTEKHNIKA, No 10, Oct 90]	35
Prospects For the Development of a Unified Series of Electron Gas Overvoltage Limiters [V. A. Volkenau, V. K. Pugachev, et al.; ELEKTROTEKHNIKA, No 10, Oct 90]	36
Switching Capacity of High-Voltage Switches and Testing Methods [N. M. Chernyshov, L. G. Kattel, et al.; ELEKTROTEKHNIKA, No 10, Oct 90]	36
Heat Liberation in Split Shielded Current-Carrying Systems [V. A. Petrushchenkov, P. V. Zhuravlev; ELEKTROTEKHNIKA, No 10, Oct 90]	36
Capacitor Bank for Pulse Generation in a Railgun [A. V. Alekseev, A. M. Baltakhanov; ELEKTRICHESTVO, No 10, Oct 90]	36
Thyatron Electric Servo With Coordinate Computers Employing Motor Rotor Position Sensors [M. A. Borovikov, V. I. Domanov, et al.; ELEKTRICHESTVO, No 10, Oct 90]	36
Electromagnetic Conduction Device [L. V. Pivovarov; ELEKTRICHESTVO, No 9, Sep 90]	37
Thermoelastic Stresses and Heat Breakdown of the Second-Kind in High-Voltage High-Frequency Ceramic Capacitors [V. A. Gnezdyn, E. I. Yermolina, et al.; ELEKTRICHESTVO, No 9, Sep 90]	37
Outlook For Consolidating U.S. and USSR Power Systems [V. V. Yershevich, Yu. L. Antimenko; ELEKTRICHESTVO, No 9, Sep 90]	37
Phase Control of Eight-Bit Microprocessor-Based Electronic Converters [Ye. Ye. Chaplygin; ELEKTRICHESTVO, No 9, Sep 90]	37
Energy Absorption Analysis of the Interaction of 0.001-10.0 MeV Electromagnetic Radiation With Electric Insulation Material [V. V. Maslov, O. Yu. Rtishcheva, et al.; ELEKTRICHESTVO, No 9, Sep 90]	38
Supplying Energy Consumers With Sharply Varying Load From Electric Power Systems [V. A. Barinov, A. A. Gurov, et al.; ELEKTRICHESTVO, No 11, 1990]	38
Theoretical Aspects and Design of High-Torque Electromagnetic Brakes [V. M. Lupkin; ELEKTRICHESTVO, No 11, 1990]	38
Evaluating Electric Grid Power Losses on the Basis of Computational Experiment Results [A. A. Arutyunyan; ELEKTRICHESTVO, No 11, 1990]	38
Mass Optimization of Combined Electromagnetic Screen [B. I. Petlenko, A. Ye. Dergachev; ELEKTRICHESTVO, No 11, 1990]	39
On Various Approaches to Calculating Volumetric Electromagnetic Force Density in Nonlinear Magnetic Systems [Yu. V. Abramkin; ELEKTRICHESTVO, No 11, 1990]	39
Author's Response [Ye. L. Lvov; ELEKTRICHESTVO, No 11, 1990]	39
Comparison of Maxwell's Formulas to Other Formulas For Calculating Electromagnetic Forces in Magnetic Field [A. V. Ivanov-Smolenskiy; ELEKTRICHESTVO, No 11, 1990]	39

UDC 791.44.022:771.447

### Use of Paraboloid Reflectors With Cellular Macrostructure in Motion Picture Lighting Equipment

917K0142A Moscow *TEKHNIKA KINO I*  
*TELEVIDENIYA* in Russian No 12, Dec 90 pp 16-19

[Article by N. T. Semenikhin, All-Union Scientific Research Institute of Motion Pictures and Photography]

[Abstract] The requirements imposed on motion picture lighting devices, such as a uniform luminous flux distribution throughout the scene and a broad defocusing range with respect to their candle power and scattering angles are described and the shortcoming of existing reflectors are summarized. It is shown that the use of parabolic reflectors with a surface structure shaped as radially concave grooves expanding from its apex toward the edges produces good results when they are used with light sources whose cylindrical luminous body is positioned along the reflector axis. Test data on such reflectors with helical and double-helix lighting bodies are cited. The design of parabolic reflectors with radial, meridional, and sagittal planes and their parameters are described. A method of applying the scattering macrostructure was developed by M. S. Shusterman at the Kiev Branch of the Central Design Office of Motion Picture Equipment in cooperation with the Scientific Research Institute of Motion and Pictures and Photography. The reflectors are being commercially produced and compared to beveled and sand blasted reflectors, have a better shape stability, are more practically feasible, more economical, and have better lighting characteristics. References 5; figures 2.

UDC 621.397.65

### Multistandard Decoder of Color Information

917K0142B Moscow *TEKHNIKA KINO I*  
*TELEVIDENIYA* in Russian No 12, Dec 90 pp 19-22

[Article by V. N. Kupriyanenko, A. M. Mymrikov, T. N. Mamanova]

[Abstract] Three methods of constructing multistandard color decoders (DTsI) are outlined and the shortcomings of two of them are summarized. The third method which is virtually free of these shortcomings is described. The method can be used with PAL, SECAM, and NTSC standards since it is oriented at a channel whose units and switchable operating modes are common to all three standards. The circuit diagram of a DTsI developed at the Elektron Scientific Research Institute of Television Engineering for fifth-generation color TV sets is presented and its operating principle in all three color standards is explained. The decoder is based on the "Satis" single-chip multistandard chromaticity processor connected to the 12C bus. Other chips (IMS) used

in the system are described. The luminance and chrominance signal separation circuit is described. References 3: 1 Russian, 2 Western; figures 1.

UDC 621.317:621.397.13

### Problems of Monitoring and Measurement in Today's Television

917K0142C Moscow *TEKHNIKA KINO I*  
*TELEVIDENIYA* in Russian No 12, Dec 90 pp 22-27

[Article by L. S. Vilenchik, Yu. A. Medvedev, Elektron Scientific Research Institute of Television Engineering]

[Abstract] Optimum test signals and algorithmic methods of checking and measuring TV channel characteristics are presented. The signals and methods are based on using both new and standard test signals and make it possible to decrease measurement errors or increase the speed of response by one to two orders of magnitude compared to traditional methods and systems; it also makes it possible to solve not only today's tasks but also to develop a metrological base for high-quality TV systems, e.g., HDTV, TDM luminance and chroma systems (MAS), digital TV signal processing and transmission systems, etc. It is shown that the check and measurement system optimization principles and the methods and algorithms synthesized on their basis can serve as the scientific foundation for developing principally new monitoring systems which will become necessary due to the need to use the frame blanking interval more efficiently than just for merely transmitting test signals. A real-time test signal distortion analysis is presented. References 17; figures 4.

UDC 621.397.132.129.037.372

### HDTV Digital Signal Coders and Decoders For Fiber Optic Line Transmission

917K0142D Moscow *TEKHNIKA KINO I*  
*TELEVIDENIYA* in Russian No 12, Dec 90 pp 27-30

[Article by E. B. Makhmudov, Kibernetika Scientific Production Association at the Uzbek Academy of Sciences]

[Abstract] Designs of a high definition television (HDTV) digital signal coder-decoder for transmission over fiber optic lines (VOLS) developed by the Kibernetika Scientific Production Association at the Uzbek Academy of Sciences are described. Coder-decoder circuits were designed for use with the Soviet component base. The digital stream compression method and compression factor are selected for transmission in a standard level 5 Consolidated Automated Communication System (YeASS) channel, i.e., 565,148 Mbit/s. The device is intended for partially compressing HDTV signals since VOLS's have an invariant characteristic - the bandwidth to transmission path length ratio. The functional diagram of the transmitting circuit and timing

charts which illustrate the coder operation are presented and various circuit components are described. The operating principle of the analog-to-digital converter (ATsP) and methods of increasing its word length are described. References 6; figures 3.

UDC 621.397.743

### Cable Television: Managing New Developments

917K0142E Moscow TEKHNIKA KINO I  
TELEVIDENIYA in Russian No 12, Dec 90 pp 37-48

[Article by A. Barsukov]

[Abstract] Mikhail Aleksandrovich Chabanovskiy, chairman of the "Videoservis" cooperative at the Odessa branch of the All-Union Scientific Research Institute of Television, is interviewed by the author; he expresses his opinion about a new management system which gives the researcher freedom to choose the direction of his scientific quest while guaranteeing competition for the funding of new scientific concepts under development. The new method of management is implemented as a scientific production company capable of solving problems rather than merely studying them. The situation in which government appropriations for science often lack the *scientific* justification and are disbursed by nameless bureaucrats is addressed. It is suggested that at least in television, this situation be corrected by funding scientific developments on a contractual basis. Examples of science and research funding by the Carnegie, Rockefeller, and Ford foundations in the United States are cited. A method of evaluating the economic efficiency of a scientific production enterprise is explained. Examples of U.S. tax statutes aimed at stimulating investment and innovation are presented.

### SSTV: Slow Scan Television

917K0115A Moscow RADIO in Russian No 12, Dec 90  
pp 26-31

[Article by Ye. Sukhovertov, Moscow]

[Abstract] The development of SSTV since the late 50's is summarized. SSTV is used to transmit TV pictures over narrow-band channels using signals with a 1200-2300 Hz spectrum, making it possible to transmit them over any telephone channel and record them using conventional tape recorders with a possibility of subsequent multiple playback. The signal structure resembles a conventional TV signal in that it contains both vertical and horizontal scan pulses as well as the intelligence video signal. These pulses are transmitted on a 1200 Hz frequency and differ only in duration. The white and black levels correspond to frequencies from 1500 to 2300 Hz while the sync pulse repetition frequency is a multiple of 50 Hz. SSTV reception and transmission, SSTV communication procedures, and the test oscillator used for adjusting and checking SSTV devices are described in detail. Figures 9; tables 2.

### Modular Individual Receiver Unit

917K0115B Moscow RADIO in Russian No 12, Dec 90  
pp 40-45

[Article by S. Sotnikov, Moscow]

[Abstract] A continuation of an article in *Radio* No. 11, Nov 90. Various designs of antennas used for receiving satellite TV programs are presented. Special attention is focused on planar antennas which represent an array of dipoles with a metal sheet reflector, i.e., phased antenna arrays (FAR). Single-reflector axysymmetric or offset parabolic antennas as well as Cassegrainian antennas with a parabolic reflector and hyperbolic subdish are described. The operating principle of parabolic antennas is summarized and formulas for calculating their gain and efficiency are presented. Specific features of European TV satellites and their operating problems are cited. Recommendations are given for designing modular individual receiving stations without low-noise amplifiers for operation in the 11 and 12 GHz band with antennas without remote control in the European part of the USSR. To be continued. References 6: 2 Russian, 4 Western; figures 6.

### 'Orion-128': Early Results

917K0115C Moscow RADIO in Russian No 12, Dec 90  
pp 46-49

[Article by V. Sugonyako, V. Safronov, Moscow]

[Abstract] The last in a series of articles describing the Orion-128 professional amateur radio computer (PRK). The authors are attempting to respond to enquiries from Orion-128 users regarding the procurement of parts, printed circuits, and manuals for connecting peripherals to the computer, etc. Specific instructions are given for substituting the scarce KR580VA86 and KR580IR82 integrated circuits and other unavailable chips and parts. Procedures for testing and adjusting specific computer components and elements are described in detail. The new ORDOS operating system developed for the PRK is summarized and the use for BASIC and ASSEMBLER languages for running the Orion-128 is described. To be continued. References 2; figures 2.

### SVP-403 Touch Channel Selector

917K0115D Moscow RADIO in Russian No 12, Dec 90  
pp 55-56

[Article by A. Potapov, Simferopol]

[Abstract] The SVP-403 touch-control program selector which is similar to the SVP-4-10 unit makes it possible to select TV programs in sets equipped with electronic channels selectors and enables the user to operate these sets together with a video cassette recorder by pushing button 6, thus changing the automatic frequency and phase control time constant of the horizontal scan device. The operating principle and circuit diagram of

the SVP-403 unit are described. The unit is characterized in that the specialized K174KN1 chip is used in the control circuit. Makes of TV sets in which the SVP-403 unit can be used are cited. Figures 2.

UDC 621.327:621.3.032.4

### New Designs and Development Outlook For Glow Discharge Starters

917K0134A Moscow SVETOTEKHNIKA in Russian  
No 12, Dec 90 pp 1-2

[Article by V. Ye. Demyshev, A. M. Kokinov, G. V. Nesenenko, All-Union Light Source Institute imeni A. N. Lodygin]

[Abstract] New designs of glow discharge starters necessitated by more stringent requirements imposed on luminescent lamps and the outlook for their development are summarized. A promising trend toward the development of new starters based on alloys with the shape memory property is described. The need to replace very scarce and expensive samarium with more easily available and cheaper alloy of lanthanum with samarium or other alloys is identified. The urgency of developing starters with an increased firing reliability or series connected lamps is recognized. The causes of starter failures are analyzed. The authors are grateful to the staff of the All-Union Scientific Research Institute of Light Sources and especially to L. G. Yemelyanova, V. V. Trunina, O. V. Ivashkova, and Yu. A. Meshcheryakov for their help. References 9.

UDC 628.955.6

### Fluorescent Concentrators As Optical Color Elements of Lighting Devices

917K0134B Moscow SVETOTEKHNIKA in Russian  
No 12, Dec 90 pp 2-4

[Article by V. K. Baranov]

[Abstract] Fluorescent concentrators (LK) used in solar power plants which make it possible to concentrate solar radiation in a certain spectral band and thus reduce the dimensions of expensive photoelectric converters of the luminous flux are summarized. It is shown that LK's can be successfully used as optical color elements in various lighting devices, including lighting fixtures and primarily decorative products, stained glass panels, etc. The LK's are a plate of transparent metal activated by a certain type of phosphor. The LK operating principle and the mechanism of the luminous flux conversion when it passes the activated plate are illustrated. It is shown that due to the fact that fluorescent radiation emerging from the plate ends and faces as well as its grooves and protrusions on their surfaces is very bright and has a pure and rich color, LK's are not only capable of considerably improving the decorative properties of products but enable designers and engineers to develop principally

new products. Pilot production of acrylic glass plates activated by various types of phosphor has begun at the Scientific Research Institute of Polymer Chemistry and Technology imeni Academician V. A. Kargin. References 3; figures 4.

UDC 621.32:536.423.1

### Evaporative Cooling of Light Sources

917K0134C Moscow SVETOTEKHNIKA in Russian  
No 12, Dec 90 pp 5-6

[Article by A. V. Atamas, Thermal Physical Engineering Institute at the Ukrainian Academy of Sciences, Kiev]

[Abstract] The shortcomings of the free and forced convection methods of cooling light sources (IS) are summarized. An experiment to cool a halogen incandescent lamp by evaporating a film of distilled water on its side surface is described. The cooling liquid film was formed with the help of capillary forces which develop in, and between, the turns of glass fiber bundles wound on the lamp's side surface and hydraulically linked through a slotted channel filled with a porous structure made from the same glass fiber filament to a reservoir with distilled water. Extraction of excessive heat ensured the performance of this capillary water feed system. It is shown that the use of filmed evaporation with a capillary water feed for cooling continuously operating mercury and halogen-filled lamps with a 0.5-1.0 kW output is quite promising. It makes it possible to improve the overall dimension and mass characteristics of cooling devices, increase their reliability by designing a pumpless, e.g., thermal siphoning, system, and decrease radiation losses due to absorption. Furthermore, evaporative cooling makes it possible efficiently to recover excess heat since this recovery will occur at a temperature level close to the cooling liquid's boiling point. References 11.

UDC 621.327.534.15

### Improving Fluorescent Lamps By Using Getter Technology

917K0134D Moscow SVETOTEKHNIKA in Russian  
No 12, Dec 90 pp 9-11

[Article by N. I. Churkina, All-Union Light Source Institute imeni A. N. Lodygin]

[Abstract] The results of extensive analytical and experimental examinations carried out at the All-Union Scientific Research Institute of Light Sources in order to outline the trends for improving fluorescent lamps (LL) by employing getter technology are presented. Designs of LL stems as well as the dependence of the sorption rate on the getter temperature and variations in the LL luminous flux stability during the tests are described. It is noted that the getter-mercury dispenser manufactured by the eastern German company Saes Getters has the optimum design since in addition to an efficient method

of using mercury, it contains a chemical evacuation device which improves the luminous flux stability and, consequently, increases the lumen output. The economic impact from the introduction of these lamps is evaluated. References 10: 9 Russian, 1 Western; figures 3.

UDC 631.326

**On Calculating Production Volume of General-Purpose Incandescent Lamps According to Their Voltage Range**

917K0134E Moscow SVETOTEKHNIKA in Russian  
No 12, Dec 90 pp 11-13

[Article by A. M. Kokinov, P. G. Chernikov, All-Union Light Source Institute imeni A. N. Lodygin]

[Abstract] An attempt is made to use available data on the demand for, and production of, general-purpose incandescent lamps (LON) so as to identify the lack of balance between their supply and demand, the possibilities of LON shortages, and certain ways of avoiding them. Annual LON production volume for various voltage ratings during the twelfth five-year plan was used as source data. The concept of "equivalent output" is introduced in order to compare quantitative output estimates of different designs of lamps with respect to their voltage ratings under real conditions. It is recommended that contracts to supply LON's be immediately signed for specific designs and voltage ratings. The need for optimization of various solutions to the problem is identified. References 4; tables 4.

UDC 628.9.002.5.004.8

**On Using Secondary Resources**

917K0134F Moscow SVETOTEKHNIKA in Russian  
No 12, Dec 90 pp 14-15

[Article by V. P. Shapurin, State Science Research Institute of Rural Development, Orel]

[Abstract] The design of highly efficient light sources with a 25-28 percent efficiency of photosynthesis-active radiation and the development of a number of principally new illumination units and systems employing the ZhUE-0.65-11 narrow-strip shutters in their lighting fixtures are described. Measures to increase the production of lighting equipment and eliminate shortages of metal-plated polyethyleneterephthalate film by using recycled fixtures which have outlived their life are outlined. Specific instructions are given for recycling used DM4-6000 and DM4-3000 lamps with UORT illuminating units. The economic impact from recycling metal-plated polyethyleneterephthalate is estimated. Principal specifications, physical and mechanical indicators, and requirements for the appearance of PET-R-A-ZhUE-50x600 film are cited. Film storage requirements are described. It is shown that extensive utilization of secondary resources in the production of lighting

fixtures for greenhouses makes it possible to increase the output of equipment in addition to solving the problem of secondary resource and used equipment utilization. References 1; tables 1.

UDC 628.94:621.317.2

**Lighting Engineering Group From 'Krasnyy Oktyabr' Plant**

917K0134G Moscow SVETOTEKHNIKA in Russian  
No 12, Dec 90 pp 18

[Article by S. A. Tikhun, Krasnyy Oktyabr Plant, Vladimir oblast]

[Abstract] The composition of the lighting engineering group and the educational and professional background of its members are summarized. The principal task of the lighting engineering group is to develop lighting and signaling equipment for vehicles, conduct photometric tests of new equipment prototypes, and prepare samples of headlights, lamps, and cat's eyes in order to certify their conformity with UN standards. Joint efforts with glass works to refine headlight diffusers and improve their quality are outlined. The operation of the group's photometry lab and lab equipment are described in detail. Today the group is involved in exploratory design work on vehicular lighting fixtures, such as using optical fiber conductors, and metal halide lamps. The need for additional equipment is identified.

UDC 628.9.(510)

**On the State of Lighting Engineering in the Peoples Republic of China**

917K0134H Moscow SVETOTEKHNIKA in Russian  
No 12, Dec 90 pp 24-25

[Article by A. Ye. Atayev, V. V. Belov, O. S. Filatov, Moscow Power Engineering Institute and All-Union Scientific Research and Experimental Design Lighting Engineering Institute]

[Abstract] The authors' visit to mainland China at the invitation of their colleagues is described. The authors visited lighting engineering enterprises and educational institutions in Shanghai and Nanking. Specific research and development efforts at these institutions as well as the range of products made in these enterprises are described in detail. Characteristic features of incandescent lamp production in PRC are outlined and the level of lighting engineering development in the country is evaluated. The visit enabled the Chinese experts and their guests to outline the principal trends of technical, scientific, and economic cooperation as well as cooperation in the field of higher education for 1991-1995.

UDC 535.6:681.784.86.001.89

### Examinations of Metrological Characteristics of Chromatometers

917K0112A Moscow SVETOTEKHNika in Russian  
No 11, Nov 90 pp 1-3

[Article by V. A. Solovyev, Chirchik Experimental Automation Design Office at the Khimavtomatika Scientific Production Association]

[Abstract] The need to establish quantitative relationships between color discrimination in units of chromaticity coordinates at various points of the color space is identified; these relations are very important for studying the metrological characteristics of chromatometers. Moreover, the principal error or at least the convergence of the chromaticity coordinate measurements should not exceed the observer's color discrimination threshold. A method for determining the color discrimination threshold in a three-dimensional frame of reference whereby the threshold is represented as an ellipsoid is proposed. Threshold contrast data are used to determine the luminance threshold while the parameters of the McAdam ellipse's semimajor and semiminor axes are used to find the other chromaticity components. It is shown that the systematic component of the photometric error should not exceed 0.0007 while the random component should not exceed 0.0027. Since a systematic error of such a magnitude is virtually unattainable in today's spectral instruments, the convergence of results in measuring color characteristics is estimated, as a rule, at the random error level. It is shown that the main spectroradiometer error does not exceed the observer's color discrimination ability. References 7: Russian 5; Western 2; figures 1; tables 2.

UDC 628.92:65.011.46

### Efficient Daylight Utilization in Transportation Buildings

917K0112B Moscow SVETOTEKHNika in Russian  
No 11, Nov 90 pp 10-11

[Article by A. M. Godin, N. P. Pinskaya, N. I. Semenikhin, Moscow Transportation Engineers Institute and Scientific Research Institute of Construction Physics]

[Abstract] Transportation buildings used to manufacture, repair, and maintain the rolling stock (PS) are characterized in that large vehicles are periodically moved inside. Due to the dark color of the vehicles and their low reflectance, they absorb and block daylight thus significantly reducing labor productivity. Numerous full-scale studies show that natural lighting is insufficient in 75 percent of the cases. The following measures are suggested for creating a favorable lighting environment in railroad depots: using combined daylight and artificial lighting with automatic daylight control; and using efficient skylights so as to utilize the natural luminous

energy more fully. The following tasks are outlined for implementing these measures: establishing the outdoor lighting dynamics by statistical processing of average annual data for Moscow; determining daylight resources, especially the lighting conditions for railroad depots with a two-shift operation; developing initial premises for designing combined lighting for principal work areas; and estimating the feasibility of using automatic devices for said buildings. The results of an analysis of combined lighting with automatic control in a Voronezh railroad depot show that an annual economic gain of 77,800 rubles was attained. References 5; figures 2; tables 1.

UDC 628.94:628.975 (048.8)

### Lighting and Signal Equipment For Heliports: A Review

917K0112C Moscow SVETOTEKHNika in Russian  
No 11, Nov 90 pp 12-15

[Article by Yu. G. Basov, Elektroluch Scientific Production Association, Moscow]

[Abstract] Heliport marking and lighting and signal facilities used to identify and delineate runways and taxiways as well as the tarmac, boundaries, and approach directions manufactured by foreign companies are reviewed. It is emphasized that these facilities must be highly reliable, durable, resistant to external factors, simple to maintain, capable of forming several versions of the lighting system, and require the least amount of time of deployment and assembly on the runway. It is shown that the luminous intensity of heliport lights and the fixtures' light scattering angles are specified in the design by ICAO regulations established on the basis of numerous operational tests under varying weather conditions. Consequently, if the system conforms to ICAO recommendations, it has the requisite lighting performance and thus can ensure helicopter takeoff and landing safety in any weather. USSR's Sineva and Svetlushka lighting systems are evaluated. References 11: 8 Russian, 3 Western; figures 6.

UDC 621.397.743 (47 + 57) + 654.197.2 (47 + 57)

### Cable Television Network Simulator

917K0114A Moscow TEKHNIKA KINO I  
TELEVIDENIYA in Russian No 11, Nov 90 pp 17-20

[Article by V. K. Marigodov, V. B. Novozhilov, S. V. Ivashkov, Sevastopol Instrument Engineering Institute]

[Abstract] Small portable dummy cable communication lines are necessary for checking quality indicators of cable TV lines in the absence of real cable networks. Known five-element passive *LRC*-filters are inconvenient since they are developed for a specific type and length of coaxial lines and become inoperable when TV system characteristics are changed. The need for a device simulating any type of cable with sufficient attenuation

is identified. The use of new-generation RF coaxial cables and fiber optic lines as dummy cable networks is described. A universal simulator of coaxial communication is proposed. Its has an attenuation frequency response of a real cable with a characteristic impedance of  $50 \Omega$  within a 0-8.5 MHz operating band and is tunable at a 1 dB step within a 1-30 dB attenuation range on an 8.5 MHz frequency. The dummy cable network design and its operating principle are described in detail. A procedure for computing the dependence of attenuation on the signal frequency as well as rated values of various elements are cited. It is shown that the new device's accuracy is sufficient for testing and developing high definition TV systems. References 5; figures 3; tables 3.

#### **Underwater Television Systems Exhibited at 'Inrybprom-90'**

*917K0114B Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 11, Nov 90 pp 74-75*

[Article by Ya. L. Butovskiy]

[Abstract] The Inrybprom-90 international fishery equipment exhibit was held in Leningrad in August 1990. The exhibit was dedicated to using modern aquatic biological resource reproduction and management facilities. Special attention was focused on using underwater TV systems (PTVS). According to the method of moving under the water surface, PTVS's are divided into three main categories: PTVS's with a submersible module carrying the transmitting TV camera on a cable; PTVS's with remotely operated submersible modules towed from a vessel; and PTVS's with self-propelled submersible modules. Various submersible modules exhibited by different foreign companies are summarized and their designs and operating principles are described in detail. PTVS's exhibited at Inrybprom-90 graphically illustrate the diversity of their designs which meet a broad range of underwater exploration requirements. Figures 4.

#### **Cable Television: A Missed Opportunity**

*917K0114C Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 11, Nov 90 pp 76-77*

[Article by A. Altayskiy]

[Abstract] The author complains that despite being one of just a few specialized publications in the field of cable and wireless television, the *Tekhnika kino i televideniya* journal was not invited to participate in the founding congress of the Cable and Wireless TV Union which opened on 1 August 1990 and criticizes the Organizing Committee for politicizing the congress and using it as

tool in its struggle with the party, State TV and Radio Committee, State Cinema Committee, and other state bodies. It is asserted that efforts of many manufacturing plants, video studios, local TV stations and cooperatives, scientific research institutes, and individual inventors are being unnecessarily duplicated for political reasons. Election of Eduard Sagalayev as president of the union instead of Dr. Yuriy Borisovich Zubarev, currently serving as Deputy Minister of Communications, is criticized due to Sagalayev's lack of expertise in the field of cable TV. In the author's opinion, E. Sagalayev has neither the moral right nor the necessary qualities for leading such an important organization.

UDC 621.397.132.129

#### **Open Cinematography System and High Definition Television**

*917K0084A Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 10, Oct 90 pp 11-17*

[Article by S. G. Muchiev]

[Abstract] The possible effect of the technology and engineering of high-definition television on cinematography is examined. This analysis is based on formulating operational performance factors of the cinematography industry as a large system and analyzing changes in these factors under a variety of technical innovations. This analysis reveals that lower interest and attendance in cinematography is due to outdated technology and distribution, while the public's interest in film is generally on the rise. It is determined that high-definition television as a new information technology will be compatible with cinematography if the latter is understood in the broadest sense.

UDC 778.57:621.397.132

#### **Test Films For Television**

*917K0084B Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 10, Oct 90 pp 18-23*

[Article by Ye. L. Nelskiy, T. N. Novikova, O. R. Prozorovskaya, V. N. Roldugin]

[Abstract] Thirty-five and sixteen millimeter positive and negative test films for television are reviewed. The test purposes of such films are examined. These include geometric distortions, frame format, raster centering, light scattering, color rendition and focusing. The test films reviewed include the ITF-1 series; the 0365M series; the IFT-3 through -9 series; the TIT-0373F series and the ITF-10 and -11 series. Specifications on these test films are given.

UDC 621.397.13:778.4

**The Limits of Depth Resolution in Stereo  
Television Systems**

*917K0084C Moscow TEKHNIKA KINO I  
TELEVIDENIYA in Russian No 10, Oct 90 pp 23-26*

[Article by V. Ye. Dzhakoniya, S. E. Koganer]

[Abstract] Stereo television system parameters including the depth of reproduced space, absolute distances from the camera to spatial objects, depthwise and cross-sectional resolving power of the system, system magnification, system transmission base and the image view distance are examined in attempting to resolve the contradiction between the need for maximum depth resolution and maximum depth of reproducible space in stereo television systems. Stereo television systems with parallel and convergent camera optical axes are compared. Fixed and variable convergence systems are examined. It is determined that an improvement in

depth resolution is achieved in variable convergence systems compared to fixed convergence systems.

UDC 621.743“313”

**Cable Television: The Practice of Contractual  
Agreements**

*917K0084D Moscow TEKHNIKA KINO I  
TELEVIDENIYA in Russian No 10, Oct 90 pp 55-56*

[Article by A. Altaiskiy]

[Abstract] The current state of efforts to legislate and control the development, expansion and distribution of cable television programming in the Soviet Union is considered. Such issues as the nature of property, the appropriateness of certain programming, the use of cable television for educational purposes, burden sharing in costs and investment as well as cable user fees are all discussed. The discussions are highly preliminary in nature as such contractual agreements are still in their very early stages of development.

UDC 621.371.029.64.001.5

**On the Effect of Radially Layered Refractive Index Fluctuations on Short Wave OTH Propagation in Tropospheric Waveguides**

917K0141A Moscow RADIOTEKHNIKA I  
*ELEKTRONIKA* in Russian Vol 35 No 12, Dec 90  
 pp 2502-2507

[Article by K. V. Koshel]

[Abstract] The issue of long-range over-the-horizon UHF-VHF radio wave propagation in a near-earth vapor waveguide with highly anisotropic refractive index fluctuations is considered. An efficient procedure for finding complex propagation constants numerically is suggested. A procedure for modeling UHF-VHF propagation in a medium with layered refractive index fluctuations is developed on the basis of this approach. The effect of fluctuations on the conditions of over-the-horizon (OTH) propagation is illustrated using specific examples. It is shown that a more efficient waveguide exists in the presence of refractive index fluctuations highly elongated along the earth's surface than in the case of a regular profile, i.e., such atmospheric irregularities lead to an additional energy channeling along the surface, as in the case of free space. References 8: 7 Russian, 1 Western; figures 2.

UDC 534.232.082.73

**Microwave Piezoelectric Transducer With Microstrip Excitation System**

917K0141B Moscow RADIOTEKHNIKA I  
*ELEKTRONIKA* in Russian Vol 35 No 12, Dec 90  
 pp 2611-2617

[Article by M. A. Grigoryev, V. V. Petrov, A. V. Tolsikov]

[Abstract] The possibilities of developing a microwave electroacoustic transducer with a microstrip excitation system are investigated. A volumetric wave microwave transducer which is a three-layered metal-piezoelectric-metal piezoid element serving as a load of a microstrip line with a matching stub is examined. The transducer operation is analyzed on the basis of the dependence of the nondimensional radiation resistance on the phase excursion in the piezoid. The requirements which ensure the piezoid matching with the circuit are formulated allowing for the loss distribution in the transmission line. The optimum characteristic impedance, piezoid area, shorted segment length, standing wave ratio (KSV), and conversion factor are found. The transducer with a microstrip excitation line is characterized by a good matching with the transmission line and has a conversion factor of about 3 dB. The resulting data may be used to design transducers of volume microwave (SVCh) acoustic waves. References 3; figures 5.

UDC 537.874.2.01

**Excitation of Open-Ended Conical Surface By Radial Electric Dipole**

917K0141C Moscow RADIOTEKHNIKA I  
*ELEKTRONIKA* in Russian Vol 35 No 12, Dec 90  
 pp 2624-2626

[Article by V. A. Doroshenko, V. G. Sologub (deceased)]

[Abstract] The problem of exciting a semi-infinite perfect conductor shaped as a circular cone with periodic slots along the generator and known opening by a radial electric dipole with known moment and radius vector is examined theoretically. Using the Kontorovich-Lebedev integral transformation and the semi-inversion method, the problem is reduced to solving an infinite system of second-kind linear algebraic Fredholm equations. The resulting analytical solution is used to examine the effect of slots on the structure and polarization of the scattered field as well as its behavior near singular points. In particular, the existence of a *T*-wave in the structure of the field scattered by the system from narrow conical area which determines the field distribution in the case where the source is located close to the apex is demonstrated. References 2; figures 2.

UDC 621.371.2.01

**Transient Electromagnetic Fields in Dihedral Angle**

917K0141D Moscow RADIOTEKHNIKA I  
*ELEKTRONIKA* in Russian Vol 35 No 12, Dec 90  
 pp 2626-2630

[Article by V. V. Borisov]

[Abstract] A waveguide system designed as a dihedron and consisting of two intersecting conducting planes where the electromagnetic field propagates at angles less than  $\pi$  is examined. Methods of representing the space-time expansion of the electromagnetic fields excited by current in such a system by separating variables and solving equations for time and one spatial variable and subsequently applying Riemann's formulas are proposed. Final expressions for the current distributed in the line, i.e., parts of a circular cone and the particular case of a point source are derived. The longitudinal component of the magnetic induction vector (i.e., directed along the dihedron edge) is calculated. It is assumed that the medium's dielectric constant and magnetic susceptibility are equal to unity and the planes are perfect conductors. It is shown that multiple reflections play a significant role in the waveguide problem and determine the directional wave propagation character. References 6.

UDC 62-501.52

**Problems of Physical Control Theory**

*917K0150A Moscow AVTOMATIKA I  
TELEMEKHANIKA in Russian No 11, Nov 90 pp 3-28*

[Article by A. A. Krasovskiy, Air Force Engineering Academy imeni N. Ye. Zhukovskiy, Moscow]

[Abstract] Numerous publications on the physical constraints and groups of basic theoretical trends currently under development which may be described as the origin of the physical theory of control are reviewed and some original findings are presented. Information approaches, microlevel control problems, problems of controlling a number of physical processes, including quantum and relativistic ones, and problems of high-efficiency control of other processes where the physical constraints on models and criteria must be seriously taken into account are classified as the essence of the physical control theory. It is shown that the physical control theory is most pertinent to determining the feasible and the impossible in automation science and to identifying objective laws of control processes. To some extent, the review addresses the issue of the expediency of sharing the intellectual potential in the control science. It is also shown that despite its short history, the physical control theory has come close to reaching its cherished goal - discovering the laws which govern control problems. It is indicated that the development of the physical control theory will facilitate a more efficient allocation of intellectual potential in the science of control. References 99: 94 Russian, 5 Western; figures 13; tables 1.

UDC 517.977.56

**On the Problem of Optimal Control Synthesis in Systems With Distributed Parameters**

*917K0150B Moscow AVTOMATIKA I  
TELEMEKHANIKA in Russian No 11, Nov 90  
pp 29-36*

[Article by F. D. Bayramov, T. K. Sirazetdinov, Kama Polytechnic Institute, Naberezhnye Chelny, and Kazan Aviation Institute]

[Abstract] The problem of optimum control synthesis which minimizes the integral quality functional and ensures the absolute stability of a closed system with distributed parameters is considered. Subsequently, the problem of local optimization whereby a set of controls which ensures the absolute stability of the system is solved. As a result, optimal control with the least value of the norm at each time moment is constructed on this set. For illustration, the problem of dampening torsional vibrations of an elastic aircraft with a constant rigidity is solved. Lyapunov's function method is used to synthesize optimal control of a system whose distributed parameters are described by partial linear differential equations. In so doing, the original equations are first

reduced to a system of first-order differential equations. It is demonstrated that all conditions of absolute stability are satisfied. References 3.

UDC 519.715:62-501.5

**Analysis of Automatic Feedback Control System by the Averaging Method**

*917K0150C Moscow AVTOMATIKA I  
TELEMEKHANIKA in Russian No 11, Nov 90  
pp 37-44*

[Article by A. V. Knyazev, Ametist Design Office, Moscow]

[Abstract] A class of automatic control systems which are described by differential equations with perturbations and contain discontinuous nonlinear functions typical of relay systems and systems with pulse-duration modulation is considered. The averaging method is used to analyze the resulting systems and is extended to the above systems as well as to the case of nonlinear functions of the locally functional type. The problem and a theorem are formulated and the proof is based on the method of point mapping developed by A. A. Andronov and Yu. N. Neymark, also referred to as the differential system trajectory shift method. References 8.

UDC 519.718

**Functional Monitoring and State Correction of Moving Object Control Loop**

*917K0150D Moscow AVTOMATIKA I  
TELEMEKHANIKA in Russian No 11, Nov 90  
pp 44-54*

[Article by A. B. Kuzmin, Air Force Engineering Academy imeni N. Ye. Zhukovskiy, Moscow]

[Abstract] One possible method of ensuring the functioning quality of a control system by functional monitoring and correction of the system's state on the basis of the monitoring data in the course of its use for designated purpose is substantiated. The quality of the mobile object control loop is evaluated. The possibility of controlling the state of the loop in the case of a failure of its elements is shown. The method is illustrated using the example of guiding an aircraft to a known fixed point at a specified time. The design and operating principle of a device for functional monitoring of the control loop state are described. References 6; figures 3; tables 2.

UDC 519.687

**Piecewise-Linear Deparalleling of Program Loops With Linear Index Expressions**

917K0150E Moscow *AVTOMATIKA I TELEMEKHANIKA* in Russian No 11, Nov 90  
pp 157-163

[Article by O. V. Lukinova, Institute of Control Problems, Moscow]

[Abstract] Data which make it possible to expand the subset of linear parallel processing loops are described. A number of loops which do not lend themselves to deparallelizing by known methods is identified in the class of multidimensional linear loops and an approach to solving the deparallelizing problem based on piecewise-linear transformation of the loop iteration space is suggested. It is shown that the proposed approach makes it possible to submit multidimensional linear loops for deparallelizing if they satisfy certain conditions and that piecewise deparallelizing makes it possible to transform over 60 percent of loops to a parallel form. In the case where the parallel loop is realized by an array processor, the deparallelizing efficiency depends on the number of deparallelizing domains, iteration space, and this space's dimensions. References 4: 3 Russian, 1 Western; figures 2.

UDC 621.385.69:537.533.2

**Electrostatically Controlled Electronic Microwave Devices With Modulated Emission**

917K0125A Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 35 No 11, Nov 90  
pp 2241-2258

[Article by V. A. Isayev, D. V. Sokolov, D. I. Trubetskoy]

[Abstract] The physics of electronic microwave (SVCh) devices which are understood here as electrostatically controlled (PEU) and modulated-emission (PME) devices is briefly summarized and theoretical and experimental results obtained in nonrelativistic OEU and PME and relativistic PME are reviewed. Devices ranging from Haeff's induction tube designed in 1939 to today's vacuum microelectronics devices are considered. Special emphasis is placed on field emission devices, i.e., femitrons, gigatrons, and vacuum integrated circuits. Research data on klystrodes, resonators, lasertrons, distributed amplifiers, traveling wave klystrons, and gigatrons are cited. Characteristic features of vacuum microelectronics devices and vacuum integrated circuits are outlined. It is predicted that more advanced devices which combine the features of vacuum microelectronics (the possibility of channeling high currents) with the achievements of solid-state integrated circuitry, e.g., film cathodes and microstrips, will be designed. References 32: 11 Russian, 21 Western; figures 12; tables 3.

UDC 537.874.1.01

**Radiator Synthesis Problem Allowing For Electromagnetic Compatibility Requirements**

917K0125B Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 35 No 11, Nov 90  
pp 2259-2263

[Article by I. M. Polishchuk, I. G. Shvayko]

[Abstract] The problem of achieving the conditional maximum gain (KU) in a given direction is considered under an additional condition that the mean radiating power averaged over a period within a certain solid angle with a symmetry axis which coincides with the extension of the dipole axis be limited and equal to a set fraction of the mean radiating power averaged over a period. The results of numerical calculations are summarized. The solution of the problem of conditional gain maximization is reduced to the task of considering a family of integral equations. The results of these calculations show that one can substantially suppress radiation within a given sector without significantly decreasing the bore-sight gain. References 5: 4 Russian, 1 Western; figures 2; tables 1.

UDC 537.874.34.01

**Output Signal Simulator of Arrays Operating in Inhomogeneous Media**

917K0125C Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 35 No 11, Nov 90  
pp 2268-2275

[Article by A. F. Maslov, K. P. Nesterov, B. P. Chernov, O. L. Korabelskiy]

[Abstract] The simulator is intended for generating RF signals received by the elements of an antenna array (AR) through correlated noise combined with additive noise. One of the methods of designing the simulator for receiving signals transmitted through an inhomogeneous medium beforehand is considered. The simulator makes it possible to form signals which correspond to different correlation radii and fluctuation dispersions of the wave's phase front passing through an inhomogeneous medium. The simulator contains a set of noise generating channels, a legitimate signal generating channel, additive white noise generators (according to the number of array elements), and adders. It is shown that experimental results are consistent with theoretical data and that the proposed method is suitable for developing simulators of signals transmitted through an inhomogeneous medium for experimental studies of multielement phased array adaptation algorithms. References 3; figures 5; tables 2.

UDC 621.396.67.01

### On the Possibility of RF Phase Conjugation in Artificial Nonlinear Media

917K0125D Moscow RADIOTEKHNika I  
ELEKTRONIKA in Russian Vol 35 No 11, Nov 90  
pp 2275-2281

[Article by V. A. Kalinin, V. V. Shtykov]

[Abstract] Today's interest in optical beam phase conjugation (OVC) at home and abroad is noted. The most efficient phase conjugation method, i.e., the four-wave beam mixing (ChVS) in a cubically nonlinear medium is described. The possibility of RF wave phase conjugation in an artificial nonlinear medium which is a combination of dipoles with a varactor load randomly distributed in space is analyzed. It is shown that for an RF resonance, the cubic nonlinear susceptibility of such a medium exceeds the corresponding value for natural nonlinearity mechanisms by several orders of magnitude. The pump intensity insuring conjugated wave generation during the ChVS in an artificial nonlinear medium is estimated. The effectiveness of a phase conjugating reflector in the ChVS generation mode is examined. A model of an artificial nonlinear medium is developed. It is shown that the proposed model can be improved by taking into account higher dipole current harmonics and the reciprocal effect of dipoles, making it possible to refine the electrodynamic parameters of the medium. It is demonstrated that low efficiency is the greatest obstacle to practical reflector applications. References 10: 6 Russian, 4 Western; figures 5.

UDC 621.391

### Dispersion Method of Detecting Determined Targets on Optical Texture and Radar Images of Earth's Surface

917K0125E Moscow RADIOTEKHNika I  
ELEKTRONIKA in Russian Vol 35 No 11, Nov 90  
pp 2295-2301

[Article by A. A. Potapov, T. V. Galkina, T. I. Orlova,  
Ya. L. Khlyavich]

[Abstract] The problem of identifying and localizing determined targets in the image texture in remote sensing, mapping, meteorology, and other tasks is described. A dispersion method of detecting determined targets on optical texture images, e.g., aerial photographs (AFS) and radar images (RLI) of the earth's surface in the millimetric wave band is considered. The potential of discriminating and localizing targets shaped as two-dimensional geometric figures on textured optical and radar images of terrestrial vegetation with the help of  $f$ -statistics at low signal/noise ratios is examined. The effect of target dimensions on detectability is analyzed. It is shown that the method is highly efficient at low signal/noise (signal/background) ratios, i.e., close to

unity. The results of the study make it possible to estimate the dispersion method's potential for various radio electronic data transmission and retrieval systems. References 15; figures 4; tables 4.

UDC 621.391.01

### Pseudorandom PSK Signal Timing

917K0125F Moscow RADIOTEKHNika I  
ELEKTRONIKA in Russian Vol 35 No 11, Nov 90  
pp 2327-2333

[Article by V. I. Prytkov, G. I. Tuzov]

[Abstract] Detection of signals with pseudorandom phase-shift keying (PSFM) is described. Markov's theory of optimal nonlinear filtering is used in a Gaussian approximation to solve the problem of synthesizing the timing system of a detector of pseudorandom PSK signals with a random phase shift angle. Synthesis algorithms are produced and specific circuit realizations of these algorithms are proposed. The timing parameter estimation accuracy is analyzed. It is noted that the phase estimation accuracy of the method depends on both the delay error and phase whereas the accuracy of delay estimation depends only on phase due to the discrimination linearity of the delay tracking system and the nonlinearity of the PLL system for any signal phase. References 2; figures 5.

UDC 621.373.5

### Investigation of Relaxation Processes in GaAs Varicap-Tuned Microwave Oscillators

917K0125G Moscow RADIOTEKHNika I  
ELEKTRONIKA in Russian Vol 35 No 11, Nov 90  
pp 2341-2345

[Article by A. A. Usoltsev, V. G. Bozhkov]

[Abstract] Schottky barrier (BSh) gallium arsenide varicaps (AGV) are extensively used in microwave (SVCh) oscillator electronic frequency tuning circuits yet their applications are often constrained by the frequency drift in tunable oscillators. It is established that frequency relaxation in GaAs varicap-tuned microwave oscillators when direct bias or pulsed voltage is applied to the varicap is determined by the low-lying level recharging in the semiconductor space charge region (OPZ). The well-known EL2 trap whose relaxation time varies from about  $10^7$  to  $2 \times 10^{-2}$  s within a temperature range from -60 to +100°C is dominant in this process and fully consistent with the frequency relaxation time. Activation energies of these low-lying levels and relaxation times are estimated within a broad temperature range. It is shown the tunable oscillator (PG) frequency relaxation method described in the article may be used to determine the low-lying level parameters in OPZ of commercial microwave diodes, especially those with a low capacitance. The results make it possible to eliminate the

causes of the undesirable tunable oscillator frequency drift. References 4: 3 Russian, 1 Western; figures 5.

UDC 621.385.69

### Relativistic Millimetric Band Diffraction Oscillator

917K0125H Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 35 No 11, Nov 90  
pp 2346-2353

[Article by S. P. Bugayev, A. N. Vlasov, V. I. Kanavets, V. I. Koshelev, V. A. Popov, V. A. Cherepenin]

[Abstract] The operation of a millimetric band sectional relativistic diffractional oscillator (RDG) is examined experimentally and theoretically. Microwave (SVCh) radiation with a 3.5 GW peak pulse power was realized in the 6.5-6.8 mm band and 4.5 GW power - in the 9-11.3 mm band. It is shown that the plasma forming on the slow-wave structure surface under the effect of electrons deposited on it and strong electromagnetic fields plays an important role in limiting the RDG oscillation duration. The microwave pulse duration was increased to 0.7  $\mu$ s in some experiments. Three oscillator frequency modes are examined and radiation characteristics are measured. Physical mechanisms of the possible effective energy transfer between the beam and the field under synchronous field irregularities typical of the millimetric wave band are identified. An experimental investigation of the beam interaction with the slow-wave circuit field reveals that the oscillation frequency is determined by the characteristics of the resonances related to the beam's transverse motion. References 9: 8 Russian, 1 Western; figures 4.

UDC 621.385.6.01

### Investigation of Space Charge Fields' Effect in O-Type Electron-Waveguide Systems With Relativistic Beams

917K0125I Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 35 No 11, Nov 90  
pp 2354-2359

[Article by N. L. Romashin]

[Abstract] The development of new O-type electron-waveguide systems with relativistic electron beams is described. A new excitation theory version is used to derive expressions for RF space charge fields of relativistic electron beams whereby the entire longitudinal field is expanded into a series in terms of eigenmodes. Expressions are found for the space charge parameter of electron-waveguide systems with various electrodynamic structures as well as under various interaction conditions. It is shown that the inclusion of dynamic space charge fields alters the dependence of the space charge parameter on the electron velocity; this dependence is determined by the type of the electrodynamic structure

and the character of interaction. It is shown that in numerical simulation of relativistic electron-waveguide systems, the effect of space charge must be taken into account using the depression coefficient expression derived in the articles. References 7.

UDC 621.396.969.11

### Two-Wave Laser Ranger-Refractometer

917K0125J Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 35 No 11, Nov 90  
pp 2420-2426

[Article by N. A. Armand, V. F. Bakhtiarov, V. P. Bisyarin, I. A. Yekimovskikh, A. N. Klebanov, V. Ye. Levin, A. N. Lomakin (deceased), V. P. Nesterov, B. N. Pavlov, S. V. Tarakanov]

[Abstract] A ranger-refractometer operating on the 0.4416 and 0.6328  $\mu$ m wavelength modulated at an 800 MHz frequency is briefly described. The dispersion method of determining the air's mean integral refractive index is used to decrease the measurement error due to the effect of the atmosphere. The ranger-refractometer makes it possible to measure the geometric length in the 2-20 km range through the atmosphere with a relative error of better than  $3 \times 10^{-7}$ , thus eliminating the need to monitor weather conditions or make corrections. When operating in an automatic mode, the instrument is capable of controlling the base line length within said accuracy for seven-eight h or more if the atmospheric transmittance permits. The instrument's accuracy can be increased by taking into account the absolute humidity thus decreasing the error to  $1 \times 10^{-7}$ . It is shown by measuring range variations in 3.8 and 17.8 km lines that the relative standard deviation is  $3 \times 10^{-7}$  and  $5 \times 10^{-7}$ , respectively, given a data averaging over several hours. Due to its stability and accuracy, the instrument is quite promising for such applications as searching for strain-induced precursors of strong earthquakes, monitoring hydroelectric plant and reservoir dam displacements, etc. References 6: 3 Russian, 3 Western; figures 4; tables 1.

UDC 621.371.029.65

### Probability Distribution Estimates of Molecular Absorption in the Atmosphere of Radio Waves at Frequencies Above 10 GHz

917K0125K Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 35 No 11, Nov 90  
pp 2439-2442

[Article by V. N. Pozhidayev]

[Abstract] It is shown that the radio wave absorption in the atmosphere at frequencies above 10 GHz in the absence of precipitation, fog, clouds, and anomalies of the air's refractive index is almost completely determined by the molecular absorption in water vapors and

oxygen since attenuation in gaseous impurities, e.g., O<sub>3</sub>, CO, N<sup>2</sup>O, etc., is much smaller due to their low concentrations. The molecular absorption probability distribution parameters are determined on the basis of experimental weather data. Successive measurements of the air temperature, pressure, and humidity under real conditions make it possible to compute variations in the molecular radio wave absorption due to the natural variability of these parameters and estimate the parameters of this absorption's probability distribution. It is shown that if in a certain time span, mean values of meteorological parameters and their variance are known at a given point, the probability of various molecular absorption values can be estimated by the normal distribution law using the formulas proposed in the article. References 6: 4 Russian, 2 Western; figures 2; tables 2.

UDC 621.396.6.089.5

#### Nonmeasurable Parameter Estimation of Radio Electronic Circuits

917K0120A Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 12-14

[Article by S. K. Savin, V. I. Polivanov]

[Abstract] The problem of estimating the nonmeasurable parameters of electronic systems (RES) using *a priori* and *a posteriori* information in order to diagnose them and monitor their status is considered. The maximum likelihood method is used to find the best estimates. The method makes it possible to reduce the extent of parameter monitoring and increase the readiness of RES's for use; the greater the interrelation between the parameters, the higher the estimate reliability, making it necessary to design and construct circuits with mutually dependent parameters. The latter can be achieved by introducing feedback between RES components or elements, designing and implementing special system monitoring and reconstruction technologies which call for adjusting parameters as a function of each other, etc. It is shown that this feedback must be negative in order to avoid excitation and increase the stability of parameters. References 3; figures 1.

UDC 621.317.729.3.087.92:621.317.335.3

#### Use of Nontraditional Antennas for Measuring Complex Dielectric Constant of Materials

917K0120B Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 22-24

[Article by S. Yu. Lapunov, A. V. Polonik]

[Abstract] Methods of nondestructive control of materials using pickups based on nontraditional antennas is considered. Various probes, microstrips, and open-ended transmission lines used as such pickups are summarized and their operating principles are described. These pickups are inserted into the controlled medium,

leading to a change in its transmittance which is recorded by measuring the conductance or complex reflectance on the antenna input. The dielectric constant of the medium is then found by variations of the parameter under study. The range of tasks involved in implementing this measurement method and the advantages of open-ended transmission lines used to examine dielectric properties of materials with considerable losses are described. A transducer executed as an open-ended coaxial line emitting into a half-space filled with the medium under study in the 0.2-10.0 GHz band is described. It is shown that the method is capable of taking measurements in small volumes of working media (about 5 ml). Compared to the best foreign instruments, the system makes it possible to examine solutions of materials with high losses. References 9: 6 Russian, 3 Western; tables 1.

UDC 531.74:513.73/77

#### Precision Capabilities of Circular Tracks in Photoelectric Shaft Digitizers

917K0120C Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 24-26

[Article by V. G. Domrachev, F. A. Kostanyan, A. P. Chibukhchyan]

[Abstract] A small photoelectric shaft position-to-digital converter in which a transparent functional track, eccentric to the rotation angle, is used to form higher-order output code digits is examined. Functional tracks which are bounded by circles are considered allowing for the disc mounting errors, spurious beats of the measuring disc, and the disc center misalignment with the converter rotation axis. The transmission function is analyzed and it is shown that the resulting analytical expressions make it possible to determine the precision capabilities of functional tracks while designing circular track shaft position-to-digital converters and thus find the maximum possible number of higher-order digits of the output code. References 2; figures 1.

UDC 531.719.2.088.228

#### Effect of Atmospheric Precipitation on Errors of Phased Range Finders

917K0120D Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 26-27

[Article by I. P. Lukin]

[Abstract] The error of phased ranging systems caused by scattering on discrete particles in the atmosphere is considered. It is shown that carrier optical wave phase distortions due to scattering on discrete particles in the atmosphere lead to both systematic and random signal phase measurement errors in most cases. The effect of optical radiation scattering on the accuracy of ranging systems is examined. The results demonstrate that the

error of phased ranging systems due to scattering on atmospheric precipitation particles does not exceed  $10^{-6}$  m while the phase measurement error of modulated signals in a turbulent atmosphere is somewhat higher. References 17: 12 Russian; 5 Western; figures 1.

UDC 531.719.24.08

### Determining Range Correction in Satellite Ranging

917K0120E Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 33-35

[Article by V. P. Nelyubina, N. F. Nelyubin]

[Abstract] Refraction and electromagnetic wave propagation velocity variability in the atmosphere lead to systematic errors in optoelectric range measurements. This error is referred to as the measured range correction. A new method of determining the range correction in measuring the distance to a satellite is developed. Computational formulas are derived and their accuracy and applicability bounds are estimated. Analytical formulas were checked by comparing them to precise values for various regions of the earth within the surface atmosphere temperature range of -60 to +60°C and a pressure range of 500-1,100 hPa in the 0.4-10  $\mu$ m band. References 8: 7 Russian, 1 Western; tables 1.

UDC 535:425:534

### Oscillator Range Finder Applications of Integrating Optical Correlator

917K0120F Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 38-39

[Article by A. A. Vetrov, Yu. V. Popov]

[Abstract] A range finder with an integrating optical correlator used for measuring the distance to diffusely scattering entities is described. The range finder circuit is designed as a twinned optoacoustic cell with a planar optical waveguide on a LiNbO<sub>3</sub> base made by thermal diffusion of titanium. The range finder contains a laser, an oscillator, photodetectors, a spectrum analyzer, a delay line, a correlator, an oscilloscope, and a recorder. The principal advantages of the proposed circuit are its 100 percent efficiency of wide band frequency modulation of the main probing laser combined with low, low-frequency control power; the independence of the correlation response from the specific modulation law which ensures the necessary bandwidth; and the possibility of executing the correlation input signal processing unit as a compact device. References 3: 1 Russian, 2 Western; figures 1.

UDC 528.517.089.6

### Pulse-Phase Solid State Laser Ranger

917K0120G Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 39-41

[Article by V. B. Volkonskiy, Yu. V. Popov, S. A. Chizhov, V. V. Yakovlev, A. D. Nizhenskiy, I. A. Ornatskiy, V. Ye. Sidorchuk]

[Abstract] Additional high-frequency pulse modulation with subsequent recording of the high-frequency envelope's phase shift is a promising method of increasing the pulsed radiation delay time measurement accuracy of solid state lasers in proportion to the distance being measured. A crystal oscillator-controlled laser activated with Nd<sup>3+</sup> developed for generating a 150  $\mu$ s nonspiking radiation pulse is described. It is shown that the new laser ranger combines the high ranging precision of phased light range finders with the possibility of measuring the distance to surfaces with diffuse reflection typical of pulse range finders. The pulse-phase light range finder block diagram is cited and its operating principle is described. A range finder prototype was designed and tested; the results shown that its additive standard deviation does not exceed 2 mm. In measuring the range to surfaces with diffuse reflection, the design maximum range reaches 250-300 m. References 2; figures 2.

UDC 681.7.089.6.088

### Systematic Errors of Optical Instrument Calibration in Remote Sensing

917K0120H Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 48-49

[Article by M. M. Mazur, V. N. Shorin]

[Abstract] Today's remote sensing instruments are calibrated in units of spectral radiance (SPEY<sub>a</sub>) whereby relative spectral characteristics of the bands are determined after which the absolute spectral response is determined in spectral radiance units. The method of measuring spectral characteristics and spectral response has a number of methodological flaws due to the failure to take into account the polarization characteristics of optical elements. Characteristics relationships between reflectance and polarization on the one hand and the diffraction grating slope (wavelength) on the other are analyzed. It is demonstrated that in order to avoid considerable errors in measuring spectral characteristics of spectral bands and the absolute sensitivity of remote sensing instruments, it is necessary to develop calibration devices which take into account polarization characteristics of optical elements. References 7; figures 3.

UDC 531.788.089.6

**New Vacuum Gauge Calibration Technique**

*917K0120I Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 52-53*

[Article by V. V. Kuzmin]

[Abstract] Due to the lack of standard absolute vacuum gauges, absolute pressure vacuum gauges cannot be calibrated by direct comparison at pressures below  $10^{-2} \text{--} 10^{-1}$  Pa. Instead, they are calibrated by a complicated dynamic process with pressure reduction which is characterized by negative side effects, primarily sorption-desorption, leading to measurement errors. A new technique developed for substantially decreasing the effect of these phenomena is described. The method is based on measuring the pressure reduction between the standard and calibrated chambers as a function of time, thus eliminating errors due to sorption and desorption, increasing the general calibration accuracy, and decreasing the effect of instability. In addition, the elimination of flow regulation procedures greatly simplifies the calibration technique. Test results show that the method makes it possible to eliminate the systematic error which increases progressively with a decrease in calibration pressures. References 2; figures 2; tables 1.

UDC 621.372.852.2.083

**Modulation-Based Method of Determining  
Channel Characteristics of Phased Antenna Array  
With Ferrite Phase Shifters**

*917K0120J Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 59-61*

[Article by L. A. Letunov, G. Yu. Mosolov, V. G. Skorov, O. Ye. Yevtyukhina]

[Abstract] The task of measuring the characteristics of phased antenna arrays (FAR) of antenna module channels with ferrite keyed phase shifters is addressed. A method of determining the parameters of ferrite phase shifters and characteristics of FAR channels by measuring the amplitude and phase of the first upper harmonic of the phase shift keying signal spectrum in these shifters is described. The method is based on an assumption that losses in FAR channels do not depend on their phase state. It is demonstrated that in restoring the PSK signal characteristics, the systematic error can be estimated using *a priori* data on the loss level for various states of the ferrite shifter. The shifter's phase state alternation diagram during keying is cited. The sequence of operations for determining the shift phases and mean PSK signal amplitude during the keying of a regular FAR ferrite shifter is described. References 3; figures 2; tables 2.

**Calibration of Reentry Vehicle  
Microaccelerometer Against Primary Standard**

*917K0120K Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 11, Nov 90 pp 69*

[Article by L. A. Savrov, K. N. Yunoshev, V. D. Yushkin]

[Abstract] An accelerometer consisting of three parallelepiped-shaped boxes oriented along the three Cartesian axes, each housing a sensor connected to a power supply source, is described. The accelerometer was calibrated against a primary standard at the Gravitation Measurements Laboratory at the State Astronomy Institute imeni P. K. Shternberg (GAISh) by tilting it on a table-top Pessler and Son level checker. A 4 h-long test did not reveal any zero drift while the accelerometer's hysteresis remained within its error. The accelerometer's scale factor is  $2.3 \pm 0.1$  mV per second. References 2; figures 1.

UDC 621.382:621.372.8

**Dielectric Waveguide-Based EHF Devices: A  
Survey**

*917K0140A Kiev IZVESTIYA VYSSHIKH  
UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA  
in Russian Vol 33 No 10, Oct 90 pp 3-11*

[Article by S. V. Koshevaya, M. V. Kononov, A. Yu. Kotomchak, D. L. Solovyev, V. A. Trapezon]

[Abstract] Published data on the development of active and passive EHF band devices based on dielectric image waveguide lines (ZDV) are summarized. Peculiar features of the most typical designs of such devices are presented. Prospects for the development of both individual ZDV-based EHF elements - oscillators, filters, valves, directional couplers, etc. - and EHF integrated circuits on their basis are evaluated. Dielectric waveguides on a metal substrate (DVM) are described. Electromagnetic wave propagation peculiarities of DVM, principal methods of waveguide coupling in EHF devices, DVM-based EHF oscillators, DVM-based channel dropping and band-pass filters, and dielectric integrated circuits are described in detail. DVM and other open-ended systems are characterized by emission and the difficulty of connecting active elements to DVM; it is shown that these shortcomings are compensated for by more lax requirements to their manufacturing precision and, consequently, their lower cost and improved mass and overall dimensions of the devices and circuits. It is shown that DVM-based EHF elements are competitive with similar devices on the basis of traditional electrodynamic systems. References 57: 27 Russian, 30 Western; figures 8.

UDC 621.372.822:852

**Monolithic Dielectric Waveguide Microwave Devices: A Survey**

917K0140B Kiev *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA*  
in Russian Vol 33 No 10, Oct 90 pp 12-18

[Article by B. Yu. Kapilevich, Ye. R. Trubekhin]

[Abstract] Microwave (SVCh) devices at frequencies above 10 GHz are being extensively implemented in civilian communication systems, such as satellite TV, mobile cellular communication, microwave lines, etc. Yet the use of microstrip lines (MPL) in them is limited by a noticeable increase in attenuation with frequency, thus prompting a search for alternate designs which combine known advantages of MPL and waveguides. The achievements and prospects in the area of microwave devices and systems employing monolithic dielectric waveguide structures are evaluated. Characteristic features of these devices' technology, their electric parameters, mass, and overall dimensions are briefly summarized. Examples of passive and active component designs on the basis of such structures are presented; their design simplicity and adaptability to streamlined production as well as low cost are noted. Passive monolithic component designs as well as tunable and active components are described in detail. It is shown that the interchangeability and other advantages of such devices make it possible to implement them in equipment for a broad range of applications. References 28: 10 Russian, 18 Western; figures 8; tables 1.

UDC 621.385.632

**Bandpass Expansion Limits of Slow-Wave Structures**

917K0140C Kiev *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA*  
in Russian Vol 33 No 10, Oct 90 pp 35-38

[Article by S. V. Mukhin, V. A. Solntsev]

[Abstract] Certain ways of expanding the bandpass of powerful traveling wave tubes (LBV) by using all-metal slow-wave structures are analyzed. Limits of TWT bandpass expansion in the short-wave direction with the help of a system of helical H-shaped or similar waveguides and in the long-wave direction using coaxial radial lines are described. It is shown that one can reach an octave gain or more with sufficient power characteristic of TWT with coupled cavity networks (TsSR) since these systems combine wide frequency bands with the possibility of good heat extraction, making it possible to use multi-beam or tubular electron currents with a large diameter. References 3: 2 Russian, 1 Western; figures 4.

UDC 621.372.832

**Wide-Band Cophased Power Dividers With One Resistive Isolator**

917K0140D Kiev *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA*  
in Russian Vol 33 No 10, Oct 90 pp 39-42

[Article by V. A. Sledkov, N. Yu. Savchenko]

[Abstract] The principal shortcoming of wide-band power dividers (DM) designed by known conventional methods is their dissipative losses at high frequencies. Attempts to solve this problem are described. Cophased power dividers with digitally tuned characteristic impedance of the matching transformer in which the output isolation is ensured by one lumped resistor and by using digitally tuned output line coupling are considered. The device is synthesized using optimization programs. Frequency responses of microstrip power dividers with finite-dimension resistors are analyzed and measured. The study demonstrates the possibility of substantially decreasing dissipative losses in wide-band DM's at high frequencies while simplifying their design. The expediency of having the necessary coupling between first section lines of the matching transformer in order to reduce line bends and the resulting irregularities is shown. References 5: 4 Russian, 1 Western; figures 2; tables 1.

UDC 537.877

**Physical Phenomena in Optically Controlled Silicon-Based Microwave Modulators Under Steady-State Conditions: Part 1**

917K0140E Kiev *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA*  
in Russian Vol 33 No 10, Oct 90 pp 47-53

[Article by O. G. Koshelev]

[Abstract] Optically controlled waveguide modulators for controlling the amplitude and phase of centimeter, millimeter, and submillimeter waves as well as optically controlled transparencies for converting and visualizing microwave fields which make it possible to obtain two-dimensional images and reconstruct and restore microwave holograms are summarized. Operating principles of an optically controlled microwave device and the effect of the semiconductor parameters and exposure conditions on their performance are considered. Numerical estimates of reflector-type silicon-based modulators at 300K are cited. The results of calculations are compared to experimental data obtained by the author. It is demonstrated that these experimental data are generally consistent with the theoretical results despite the simplifications in the analysis of the phenomena which determine the operation of optically controlled devices. References 5: 4 Russian, 1 Western; figures 5.

UDC 621.372.852.1

### Monolithic Dielectric Meter and Decimeter Band Filters

917K0140F Kiev *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA*  
in Russian Vol 33 No 10, Oct 90 pp 62-64

[Article by M. Ye. Ilchenko, G. A. Mirskikh, V. A. Syzranov]

[Abstract] Cavities made as coaxial transmission line sections filled with a dielectric, i.e., coaxial dielectric resonators (KDR) which are widely used for solving the problem of signal frequency discrimination and are compatible with hybrid integrated circuit elements, making it possible to miniaturize meter and decimeter band systems, are summarized. A transition from KDR-based filter elements to monolithic structures preserves the overall dimensions of filters while improving their performance and making them more stable to mechanical and climatic factors is outlined. A comb design which is convenient from the viewpoint of monolithic dielectric filter tuning and its compatibility with microstrip elements of hybrid integrated circles is described. The dependence of the resonant elements' coupling with each other and external circuits on the geometric parameters of structural elements is established and the frequency response (AChKh) of the filter is analyzed. The resulting data attest to the good outlook for using monolithic dielectric filters in meter and decimeter band systems and the expediency of improving the methods of their development and refining the their design and manufacturing technology. References 4: 3 Russian, 1 Western; figures 3.

UDC 621.382

### Frequency Response Analysis of Millimeter Band Transistorized Amplifiers

917K0140G Kiev *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA*  
in Russian Vol 33 No 10, Oct 90 pp 74-75

[Article by V. V. Muravyev, A. A. Tamelo, G. A. Godun]

[Abstract] The development of FET or high-carrier-mobility transistor millimeter and submillimeter band amplifiers is hindered by the problem of matching the transistor's input and output impedance with microstrip transmission lines. Short-circuited (KZ) sections of transmission lines are recommended for solving this problem yet due to the difficulties of implementing KZ section, capacitor-loaded sections are used. A typical design of an amplifier with such sections is described and the results of analyzing its frequency response (AChKh) at various phase-path lengths of the amplifier topology is analyzed. The conclusion is drawn that it is possible in a relatively simple millimeter band amplifier topology to attain a 16 percent GBW product which is flat within 1 dB

with a less than quarter-wave phase-path length of the shorting stubs compared to nonoptimized parameters. References 3: 2 Russian, 1 Western; figures 4.

UDC 621.373.52

### Varactor-Tuned Self-Biased Gunn Oscillator

917K0140H Kiev *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA*  
in Russian Vol 33 No 10, Oct 90 pp 83-84

[Article by P. A. Borodovskiy, A. F. Buldygin]

[Abstract] The electrical range of a varicap-tuned Gunn oscillator is estimated using Slater's perturbation theorem assuming that the electric field energy stored in the varicap changes by a quantity determined by the capacitor modulation index when the bias voltage is changed. For simplicity, at high microwave voltage amplitudes the varicap's volt-ampere characteristic is approximated by a straight line. The design of a self-biased 8 mm band varicap-tuned Gunn oscillator is described. It is noted that for calculating the maximum tuning bandwidth, it is necessary to know the varicap's Q-factors and modulation index. It is shown that since in the 8 mm band the frequency response of the varicap and Gunn oscillator are difficult to measure, the necessary electric tuning band in this case must be obtained empirically by trial and error, using different varicaps, Gunn oscillators, and waveguide resonator lengths. References 2; figures 2.

UDC 621.372.852.2:621.382

### Possibilities of Expanding Microwave Phase Shifter Bandwidth

917K0140I Kiev *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA*  
in Russian Vol 33 No 10, Oct 90 pp 88-90

[Article by B. V. Viktorov, V. V. Vorobyev, N. V. Drozdovskiy]

[Abstract] The potential of expanding the bandwidth of switched-channel transmission phase shifters (FVPK) often used in various microwave devices is estimated. Since the development of resonance phenomena in a close-ended channel cannot be ignored in estimating the phase shifter bandwidth, a method of connecting two additional switched microwave diodes in order to suppress these resonance phenomena in the close-ended channel and expand the bandwidth is suggested. The results of a numerical analysis of an FVPK circuit with two additional diodes are presented. Ninety and 180° shifters are analyzed and their layout diagram is cited. It is shown that the use of additional diodes for suppressing the undesirable resonance phenomena in close-ended channels combined with correct selection of the distance between these diodes make it possible considerably to expand the switched-channel phase shifter bandwidth. References 4: 2 Russian, 2 Western; figures 3.

UDC 621.376.4

**Tunable Microwave Phase Manipulator**

917K0140J Kiev *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA*  
in Russian Vol 33 No 10, Oct 90 pp 92-94

[Article by A. V. Ulyanov]

[Abstract] A microwave manipulator for transmitting digital signals with binary phase-shift keying (FM-2) containing a power divider, a set angle shifter, two binary attenuators in energy transmission channels, and an output microwave combiner is described. The shortcomings of various types of such keyers are summarized and their causes are identified. Ways of attaining the phase difference stability necessary for radar applications are outlined and methods of simplifying the microwave keyer without reducing the FM-2 accuracy are summarized. A microwave phase manipulator executed on a voltage-tunable magnetron (mitron) which makes it possible to decrease the phase difference instability inherent in magnetron-based keyers to its potential is described. An experimental test of the mitron used as an FM signal amplifier revealed that a gain on the order of 20 dB could be obtained within a synchronization band of over 10 MHz with a 60-70 percent efficiency at 10 cm band frequencies. It is shown that the coded PSK signal's power or tuning band and center frequency may be increased significantly by using a magnetron-type device with several ports in the microwave phase manipulator. References 5; figures 4.

UDC 621.396.66

**Steady-State Errors and Transient Process in Dual-Loop Phase Lock Systems of Long Microwave Line**

917K0140K Kiev *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA*  
in Russian Vol 33 No 10, Oct 90 pp 95-96

[Article by G. P. Zemtsov, S. O. Plotnitskiy]

[Abstract] Steady state errors and transient conditions in phase lock systems of a long microwave line with two phase detectors used for producing synchronous microwave oscillations in large antenna arrays and measuring the phase of microwave oscillations are analyzed. Block-diagrams of two phase lock systems of a microwave line employing the modulated reflection method for measuring the phase-path length are presented. The operation of the dual PLL system is described in detail. It is emphasized that the modulated reflection method is insufficient for obtaining data on the phase-path length during a time shorter than the modulating oscillation period of the oscillator and that the oscillation period must be several times smaller than the requisite speed of

response. Transient processes were calculated on a computer using the Runge-Kutta method. References 1; figures 4.

UDC 621.372.832.6

**An Interference Grating**

917K0082A Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 35, No 10, Oct 89 pp 2054-2061

[Article by V. M. Osipenkov]

[Abstract] A new device, called an interference grating, is proposed for use in performing two simultaneous functions: coupling of two microwave (T-wave) transmission lines and performance as a directional coupler. This is achieved by employing multiple transmission line sections in the interference grating that are in turn connected to external networks. The interference grating can easily be implemented by means of coaxial or strip-type transmission lines. A block diagram of the grating connections and a cross sectional view of a strip-line implementation of the simplest interference grating are provided. The frequency characteristics of crosstalk attenuation and directivity of such a grating are plotted and the electrical specifications are given. Analysis reveals that as the coupling between conductor groups in the grating diminishes, the operational frequency range expands, and the directivity is enhanced. This interference grating can be used as a base element in three-dimensional integrated circuits. Its performance characteristics are superior to those of existing devices with similar applications.

UDC 621.396.67.01

**Ferrite Rod Gratings and Their Application to Millimeter Waves**

917K0082B Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 35, No 10, Oct 89 pp 2061-2065

[Article by V. V. Meriakri, I. P. Nikitin, M. P. Parkhomenko, A. N. Sivov, A. D. Shatrov]

[Abstract] A magnetodielectric (ferrite) rod grating design is analyzed theoretically and experimentally for applications in the millimeter wavelength band. The analysis focuses on the change in magnetic susceptibility in the grating plane induced by interaction with a plane electromagnetic wave incident on the grating. The problem is reduced to a problem of wave scattering by a waveguide inhomogeneity. The experimental analysis is carried out on a grating fabricated from multiple 2.78 X 3.02 X 50 mm 1SCh4 rectangular ferrite rods. The grating was mounted at the focus of a gaussian beam for transmission coefficient measurements. Such measurements reveal that the experimentally-measured transmission coefficients and the theoretically-predicted

values are in good agreement. The transmission coefficient is found to be controllable by the applied external magnetic field. This property of the magnetodielectric gratings may find broad application in millimeter wave radio engineering.

UDC 621.396.67.01

### An Optical Theorem for Receiving Antennas and its Consequences

917K0082C Moscow RADIOTEKHNika I  
ELEKTRONIKA in Russian Vol 35 No 10, Oct 89  
pp 2065-2071

[Article by G. A. Yerokhin]

[Abstract] The requirements that minimize or maximize the integral scattering characteristics, and, therefore, the differential scattering characteristics of receiving antennas with a matched load are determined based on an existing optical theorem. The optical theorem is formulated on the basis of scattered fields corresponding to two operating modes: complete antenna matching to the load and a transmission mode. Certain consequences of the optical theorem for receiving antenna design are discussed, including the problems of energy reradiation by these antennas. The limiting cases of minimum and maximum antenna scattering are analyzed. These results can be used in designing antennas with prescribed scattering properties.

UDC 621.391.01

### Post-Detector Phase Detection of Weak Signals in Nongaussian Noise

917K0082D Moscow RADIOTEKHNika I  
ELEKTRONIKA in Russian Vol 35 No 10, Oct 89  
pp 2072-2080

[Article by V. S. Voshchenko, Ya. Yu. Nikitin, R. P. Filimonov]

[Abstract] A phase method of post-detector detection of weak signals under gaussian noise conditions is examined and an optimum detector design based on a likelihood relation statistic is proposed. The method is based on an analytic expression for the probability density of the phase. Expressions are derived for the local effectiveness measures of the corresponding detection rules in terms of Kulback-Leibler information in order to compare the effectiveness of phase and amplitude techniques for the case of arbitrary interference. These equations are then used as the basis for formulating a locally-most-powerful rule and its rotation-invariant modification. It is demonstrated that, in both cases, the form of the statistic used as the basis for rule analysis is identical to the classical Raleigh criterion. The nonparametric nature of these detection routines makes them fundamentally different from amplitude detection methods.

These phase methods have a greater maximum asymptotic effectiveness compared to amplitude methods.

UDC 621.372.8

### Implementation of Microstrip Microwave Power Devices

917K0082E Moscow RADIOTEKHNika I  
ELEKTRONIKA in Russian Vol 35 No 10, Oct 89  
pp 2142-2145

[Article by V. A. Repin]

[Abstract] The concept of a point resistance region is introduced for analyzing microstrip microwave power devices. The dependence of the maximum possible specific power dissipation on the dimensions of the device is analyzed and the possibility of increasing the maximum possible power dissipation level by increasing the dissipation level of the resistive film region is considered. The analysis focuses on heat dissipation from an (a X a) square region on a dielectric substrate. The board is mounted on an ideal heat sink. It is determined from this analysis that it is possible to substantially increase the specific power dissipation by using a set of discrete resistive regions—point resistance regions—rather than a large solid resistive region. The maximum specific power dissipation of the resistive layer also depends on the distance between the point resistance regions. This new concept has made it possible to develop a new type of microstrip microwave load with elevated specific power dissipation levels (1,000 watts per square centimeter) on polycore substrates.

UDC 537.533.2

### Calculation and Experimental Investigation of an Industrial Electron Gun

917K0082F Moscow RADIOTEKHNika I  
ELEKTRONIKA in Russian Vol 35 No 10, Oct 89  
pp 2146-2155

[Article by L. A. Neganova, V. A. Syrovoy, V. N. Tskhay]

[Abstract] A general purpose industrial electron gun producing an acceleration voltage up to 30 kilovolts at a current up to 4 amps, a compression of the order of 3 and an initial beam divergence of 30 degrees is designed and an experimental analysis of a prototype of the electron gun is carried out. The design is based on integration of a paraxial equation and the use of a "false" asymptotic representation. The "Era" applied program package is employed in the computer modeling and subsequent fabrication of the general-purpose industrial electron gun. The gun was tested on a test stand producing an acceleration voltage up to 25 kilovolts in a 0.5 microsecond single-pulse operating mode. These experimental

tests revealed an agreement between the integral parameters of the electron beam flux and calculated data. It is determined that this design approach makes it possible not only to obtain null and accelerating shaping electrodes, but also a profiled lateral cathode surface, which, together with the negative equipotential, can be used to calculate a theoretically-optimized thermal gap. The general method can be used to successfully design industrial axisymmetrical electron guns with predetermined parameters.

UDC 621.376.2

**Theoretical and Experimental Investigation of a New Type of Millimeter Band Frequency Converter**

917K0082G Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 35 No 10, Oct 89  
pp 2172-2179

[Article by N. V. Budilovich, A. Ye. Yekzhanov, I. A. Strukov]

[Abstract] A mixer design with waveguide signal and master oscillator circuits in which the matching diaphragm and intermediate frequency circuit are fabricated by printed circuit board technology on a polyimide film is proposed. A waveguide mode transformer is employed for converting an asymmetrical waveguide mode into a symmetrical mode that is nonpropagating in a waveguide of standard cross-section. A numerical optimization is carried out to accelerate the design of waveguide mode transformers for different frequency ranges and to improve the design of existing devices. A mixer prototype with waveguide signal and master oscillator circuits for operation in the 8 millimeter range is fabricated for testing and comparison purposes. The effective input noise temperature in operation is 300 K at an output impedance of 100 to 200 ohms. Plots of the frequency dependence of the transmittance are given for the waveguide mode transformer used in the prototype together with the frequency dependence of losses in the mixer. These results reveal a good agreement between theory and experiment. The optimum oscillator power in this design is 1.5 to 2 milliwatts. This is 3 dB lower than in a traditional orthomode mixer. The mixer can find applications as a device whose master oscillator must be compact and operate at low power levels.

UDC 537.624.01

**Calculation of a Stationary Magnetic Resonance Signal in Optically Oriented Atoms Excited By an RF Pulse Sequence**

917K0082H Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 35 No 10, Oct 89  
pp 2179-2183

[Article by V. V. Semenov, N. F. Nikiforov, S. V. Yermak, V. V. Davydov]

[Abstract] Stationary magnetic resonance is calculated in optically oriented atoms under excitation conditions. The stationary magnetic resonance signal excited by the rf pulse sequence in this case is calculated from existing solutions for the magnetic vector components over a time interval equal to the pulse repetition period. A table of the relative intensities and spectral components of the magnetic resonance signal induced by the pulsed rf field is provided. The rf field parameters are found to have optimum values whose criteria include the Q-factor of the resonant line. The rf line broadening effect was also determined to be absent for all satellite-lines. The optimum values for the rf field parameters suggest competition between the optical pumping, relaxation and rf pulsed processes. The absence of rf line broadening indicates a predominant role of relaxational processes compared to rf action due to the large relative pulse duration.

UDC 621.396.96

**Evaluating Synthetic Aperture Radar Resolution Through Noise Interference**

917K0121A Moscow RADIOTEKHNIKA in Russian  
No 10, Oct 90 pp 6-8

[Article by V. M. Shlyakhin]

[Abstract] The effect of the number of noncoherently composed image signal realizations in a synthetic aperture radar (RSA) on the point reflector resolution probability is evaluated quantitatively in the case where the fluctuating-phase signals generated by these reflectors are detected against the background of additive white Gaussian noise. The effect of noise on the Rayleigh estimate of the RSA resolution in observing point reflectors which form secondary signals with a random initial phase is considered. Analytical relationships between the noise power and the number of incoherently composed radar images are derived. It is shown that while increasing the uncertainty of resolution estimates and decreeing their reliability, noise interference largely negates the positive effect of incoherent image signal composition making it necessary to take this fact into account in designing RSA's. References 6: 5 Russian, 1 Western; figures 1.

UDC 621.391

**Analysis of Spatial Smoothing in Angular Signal Correlation Tasks**

917K0121B Moscow RADIOTEKHNIKA in Russian  
No 10, Oct 90 pp 11-14

[Article by A. B. Gershman, V. T. Yermolayev, G. V. Serebryakov]

[Abstract] A comparative analysis of the possibilities of decorrelating external signals using both the conventional spatial smoothing method and its modification

based on the property of correlation matrix (KM) per-symmetry of the antenna array's (AR) input signals is conducted. The analysis is aimed at improving the efficiency of adaptive spatial processing procedures and raising the resolution of nonlinear angular resolution methods for correlated signals. It is shown that the modified method of spatial smoothing is more efficient for decorrelating cross-correlated external signals than the conventional spatial correlation method and may be used to increase the spatial signal processing efficiency in antenna arrays. References 7: 6 Russian, 1 Western.

UDC 621.391.8:519.2

### Reversible Transformations of Random Processes With Fractional-Rational Spectral Density in Digital Analog Signal Processing Systems

917K0121C Moscow RADIOTEKHNIKA in Russian  
No 10, Oct 90 pp 16-17

[Article by Ye. A. Smirnov]

[Abstract] The problem of generating a discrete Gaussian random process representing samples of a continuous random process with a given correlation function which arises in computer simulation of radio engineering devices and the inverse problem of bleaching or reducing correlated discrete noise samples to independent Gaussian samples which arises in the problem of optimal digital radio signal processing device synthesis are considered. A computation method which makes it possible to calculate the weight factors of a digital filter for forming or bleaching a random process obtained by sampling a continuous process with a rational-fractional spectral density is proposed. It is shown that the technique may be used to compute weight coefficients in approximating the random process' spectral density by various procedures. References 1.

UDC 621.372.852.2

### Analog Microwave Phase Shifters

917K0121D Moscow RADIOTEKHNIKA in Russian  
No 10, Oct 90 pp 29-30

[Article by A. R. Tagilayev]

[Abstract] Designs of analog phase shifters based on the principle of combined utilization of phase shifters with analog and discrete phase shifts are suggested and the results of an experiment which confirms the possibility of developing miniature analog phase shifters with improved characteristics are cited; they are aimed at improving the phase shift setting accuracy of controlled phase shifters used in phased antenna arrays (FAR). It is shown that miniature analog phase shifters (FV) with improved characteristics can be developed and that the use of the proposed analog FV with analog phase control of at least 360° in FAR's with an automatic phase control

system makes it possible to improve the radiation pattern and increase the radiation direction setting accuracy. References 1; figures 2.

UDC 621.391

### Spatial Filtering Efficiency As a Function of the Number of Position of Interference Sources

917K0121E Moscow RADIOTEKHNIKA in Russian  
No 10, Oct 90 pp 37-40

[Article by M. V. Ratynskiy]

[Abstract] The decrease in directive gain (KND) accompanying adaptive spatial filtering is estimated as a function of the number and position of noise sources; radiation pattern (DN) distortions of a phased antenna array (FAR) which occur in this case are illustrated. It is demonstrated that spatial interference filtering in an adaptive FAR in the case of a virtually complete interference suppression is accompanied by a degradation of the signal to interference+noise ratio (S-PSh) compared to the case where there is no interference as a result of the aforesaid decrease in the array's directive gain. It is shown that the S-PSh degradation which directly depends on the effective number of interference sources becomes significant only when this interference falls within the major lobe (GL). It is also shown that analytic estimates are consistent with the results of digital simulation; the latter demonstrate the array's major lobe distortions which accompany the decrease in its efficiency (KPD). This decrease is small under the effect of noise on the side lobe (BL) and is considerable under its effect on the GL. References 6: 4 Russian, 2 Western; figures 3.

UDC 621.396.677.49

### Analysis and Synthesis of Antenna Array With Sector-Shaped Partial Radiation Patterns

917K0121F Moscow RADIOTEKHNIKA in Russian  
No 10, Oct 90 pp 44-47

[Article by S. P. Skobelev]

[Abstract] The possibility of shaping sector-shaped partial radiation pattern (PDN) by one antenna array (AR) is examined. An AR which is a modular periodic structure with a period of  $a$  is proposed; each module has two radiators located at a distance of  $a/2$  from each other which are fed through balanced two-channel power dividers and through stages of directional couplers. Since each stage contains couplers both between the modules and directly in them, it is possible to form overlapping subarrays. The values of coupler parameters at which sector-shaped partial radiation patterns are shaped are derived. It is shown that specific designs call for a more rigid analysis which would take into account component imperfections and the interaction of radiators in space. References 6; figures 3; tables 1.

UDC 621.372.5(075.8)

**Determining Electromagnetic Field Components on Uniform Earth Surface Excited By Aerial Wire**917K0121G Moscow RADIOTEKHNIKA in Russian  
No 10, Oct 90 pp 47-49

[Article by V. F. Kalyuzhnyy]

[Abstract] Field components necessary for measuring the loss power and longitudinal parameters of an equivalent cylindrical earth wire are found. A model of the "aerial wire—uniform earth" line is proposed; the flat earth is substituted with a cylindrical wire whose radius is equal to the penetration depth of the cylindrical electromagnetic field into a cylindrical wire; the model is equivalent to a two-wire line with cylindrical wires with different dimensions made of different materials while the equivalent radius of the return earth wire is made equal to the depth of cylindrical electromagnetic field penetration into a cylindrical conductor with uniform earth parameters. It is shown that the resulting expressions for determining the electric and magnetic field strength components on the earth's surface make it possible to compute the return earth wire impedance allowing for its DC resistance, skin effect, and the wire proximity effect; it is also demonstrated that the aerial wire parameters can be calculated on the basis of the above expressions. References 8: 6 Russian, 2 Western; figures 1.

UDC 621.396.96

**Adaptive Array Quality Criterion Allowing For External Noise Correlation**917K0121H Moscow RADIOTEKHNIKA in Russian  
No 10, Oct 90 pp 51-53

[Article by A. I. Stashkevich, S. S. Shchesnyak]

[Abstract] The possibility of using the standard deviation minimization (MSKO) criterion under the conditions of external noise correlation in the channels of an adaptive antenna array (AAR) is considered; to this end, the criterion of the MSKO between the array's reference and output signals which takes into account noise correlation in the adaptation channels is examined. An expression is derived for the optimum weight coefficients of an adaptive antenna which realizes this criterion. It is shown that the criterion may be used to estimate the capabilities of AAR's based on the MSKO criterion in the case of external noise correlation in its channels, making it possible to expand AAR capabilities with regard to shaping the radiation pattern and controlling the side lobe level. References 4: 3 Russian, 1 Western.

UDC 621.316.722.1

**Piezoelectric Semiconductor Secondary Power Supply Source For Charging Capacitive Integrators**917K0121I Moscow RADIOTEKHNIKA in Russian  
No 10, Oct 90 pp 76-78

[Article by S. G. Bochkarev, D. G. Voronin, G. A. Danov, V. V. Drozhzhev, D. A. Kocherov, V. N. Frolov]

[Abstract] A piezoelectric semiconductor secondary power supply source (IVEP) for charging capacitive integrators which are based on specialized LSI circuits (BIS) and employ the frequency control method of the piezotransformer is described. The mass and overall dimensions of the IVEP's greatly exceed those of similar devices with an electromagnetic transformer. The proposed design was tested; it is shown that the added relative pulse duration control ensures high IVEP efficiency during the entire integrator capacitor charging period. The bridge-type power amplifier circuit used in the design ensures a high piezoelectric transformer input capacitor recharging rate. References 2; figures 4.

UDC 621.372.061

**A Comparison of Methods For Analyzing Electronic Circuit Dynamic Characteristics**917K0124A Kiev ELEKTRONNOYE  
MODELIROVANIYE in Russian Vol 12 No 5,  
Sep-Oct 90 pp 25-31

[Article by Yu. M. Gusarov, S. P. Loskutnikov]

[Abstract] The comparative characteristics of the most popular implicit integration methods, including the Euler, FDN, Schiffman and second-order implicit-explicit methods, for computer-aided design of standard test circuits employing the ASMA program package, are examined. These methods are used for integration of ordinary differential equations. The second-order methods were found to be the most effective in terms of the number of Newton iterations for all test problems run. When these methods were used, the best results were obtained in combination with Gear and corrected-Gear step selection algorithms.

UDC 681.32.06

**Methods of Recovering Diagnostic Information From Signatures**917K0124B Kiev ELEKTRONNOYE  
MODELIROVANIE in Russian Vol 12 No 5,  
Sep-Oct 90 pp 64-69

[Article by O. N. Dyachenko, A. N. Tarasenko]

[Abstract] The advantages of employing signature analysis for recovery of diagnostic information are outlined.

A simple algorithm is synthesized for recovering information on single-bit errors from a derived signature. This bit error algorithm is easily implemented by means of a single-input signature analyzer. This signature analyzer can also be used for compression of a one-dimensional output test sequence and for localization of certain erroneous bit packets.

UDC 621.311:681.51

**Program For Evaluating Intersystem Power Transfer in the Main Network of an Interconnected Power System**

917K0124C Kiev ELEKTRONNOYE  
MODELIROVANIYE in Russian Vol 12 No 5,  
Sep-Oct 90 pp 84-89

[Article by V. G. Derzskiy, I. G. Kudras, A. G. Batalov]

[Text] The development of a fundamentally new mathematical apparatus that accounts for the probabilistic nature of power transfer based on a minimum of raw data and permits real-time estimation of power transfer levels in the main network of an interconnected power system is reported. The program, which is called the Soviet-D program, is designed for analyzing controlled section power transfer in an interconnected power system consisting of at least ten systems, thirty-two controlled sections and 128 controlled lines. The program utilizes multiple linear regression whose predictors include daily demand schedules and external power transfers. The Soviet D program is currently in use on the Main Network of the Ukrainian Interconnected Power System for real-time monitoring of daily inter-system power transfer modes.

UDC 681.382

**Algorithm For Selecting a Method of Solving Linear Equations For Topological Modeling of Semiconductor Devices**

917K0124D Kiev ELEKTRONNOYE  
MODELIROVANIYE in Russian Vol 12 No 5,  
Sep-Oct 90 pp 108-109

[Article by A. N. Bubennikov, A. V. Chernyaev]

[Abstract] The development of an integrated algorithm for selecting direct methods of solving linear algebraic equations for multidimensional topological modeling of semiconductor devices is reported. The algorithm is tested in stationary and nonstationary modeling of an emitter follower using a two-dimensional topological model of a transistor structure. Plots of the computer calculation volume versus the number of unknowns in the modeling process are provided. It is determined that utilizing this integrated algorithm makes it possible to reduce computation time for a topological model by a

factor of 2 to 3 for 1,000 to 1,500 unknowns compared to the Kholetskiy incomplete factoring method with conjugate gradients.

UDC 621.396.96

**Accuracy of Estimation of Target Position and Motion By Coherent Multiposition Instrument Systems Using Broadband Signals**

917K0079A Kiev IZVESTIYA VYSSHIKH  
UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA  
in Russian Vol 33 No 9, Sep 90 pp 3-7

[Article by S. G. Nakhmanson]

[Abstract] The coordinates and coordinate derivatives of a target accelerating in the far field and the Fresnel zone of coherent multipositional instrument systems employing space-time processing of broadband signals are estimated. New analytic expressions that determine the maximum joint estimation accuracy of the range, radial velocity and acceleration of a target under these conditions are derived. It is determined that the accuracy of estimation of target acceleration travelling radially in the far field for the case of optimum space-time broadband signal processing diminishes with increasing signal broadband factors, thereby confirming that acceleration estimation accuracy diminishes in the case of frequency modulation of the signal. It is also established that the range, radial velocity and acceleration estimation accuracy for a target in the far field of the coherent multiposition instrument system is higher, the lower the broadband factor, the higher the signal compression coefficient and the closer the target is to the instrument system.

UDC 621.396.969.3

**Comparative Analysis of Scaling Methods in Signal Spatial Processors Using Fixed-Point Operations**

917K0079B Kiev IZVESTIYA VYSSHIKH  
UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA  
in Russian Vol 33 No 9, Sep 90 pp 7-12

[Article by V. V. Zakharov]

[Abstract] A generalized mathematical model of determining shift error in scaling of bits in a signal spatial processor using fixed point operations is developed. This processor calculates the scalar product of two vectors. The mathematical model is used to analyze the required number of processor bits for two scaling methods. Iterative scaling is found to reduce the required number of processor bits.

UDC 621.396.677

**Phase Adaptation Algorithm For Antenna Arrays of Arbitrary Geometry**

917K0079C Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 33 No 9, Sep 90 pp 30-34

[Article by Yu. M. Shchapov]

[Abstract] The possibility of modifying the biquadratic programming method for use with a phased antenna array of arbitrary geometry is considered. The primary quality factor of the phased array is the signal-to-noise ratio at the device output as determined by the Rayleigh ratio. A new, simple iterative phase adaptation algorithm is proposed as the modification. The optimum coordinate-phase step on the channels of the adaptive antenna array is determined based on three noise power measurements at the output of the device. The primary advantage of the new algorithm is simplicity, which makes possible real-time utilization of the algorithm for phase adaptation of phased antenna arrays.

UDC 621.6.677.49-472.2

**Interference Suppression in a Single-Sideband Angle Modulation Signal Receiver**

917K0079D Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 33 No 9, Sep 90 pp 75-76

[Article by M. M. Shakhmaev]

[Abstract] A physical principle of interference suppression is proposed for use in single-sideband angle modulation receivers. This principle is based on maintaining the sign of the derivative of the additive mixture of the signal and interference which matches the sign of an arbitrary modulating signal. An interference suppression device consisting of a differentiating network, amplitude limiters, a comparison unit, an electronic switch and an integrator, is proposed. Equations are derived for a quantitative estimation of the interference suppression level. It is found that the proposed device increases the output signal-to-noise during the entire cycle of the receiver.

UDC 621.396.96

**The Effect of Nonidentical Frequency Responses of Receive Circuits on the Effectiveness of Multichannel Digital Spatial Signal Selection Filters**

917K0079E Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 33 No 9, Sep 90 pp 77-79

[Article by V. N. Manzhos, V. N. Kokin, A. K. Fedorov]

[Abstract] The energy losses on a multichannel processing circuit resulting from amplitude-phase and frequency irregularities which are generally assumed to be random are analyzed. In order to determine the signal-to-interference ratio at the output of the multichannel processor with nonidentical receive channels the primary optimum processing operation is written as a correlation integral in the frequency domain. This equation is used to formulate an optimum processing algorithm that is insensitive to irregularities on the receive channels. An estimate of a reference vector required for utilization of this algorithm is obtained by presenting a set of reference scalar signals with the anticipated parameter values to the inputs of the distortion channels. Use of the optimum algorithm virtually eliminates legitimate signal losses even under severe interference conditions and with substantial irregularities of the processing circuits.

UDC 621.396.67

**Partial Directional Pattern Control of a Waveguide Phased Array by Means of a Perforated Surface**

917K0079F Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 33 No 9, Sep 90 pp 84-86

[Article by V. P. Kudin, N. I. Shlyk]

[Abstract] A radiator design with a perforated dielectric surface is analyzed for use in partial directional pattern control of a waveguide phased array. The array is an infinite phased antenna array of circular waveguides with the elements in a skew-angular grid configuration. A system of integral equations is derived for determining the characteristics of the phased array. The characteristics of the circular waveguide in the infinite array at the nodes of a hexagonal grid are investigated. An analysis reveals that the resonance of the surface wave shifts toward the normal to the array plane with increasing frequency, while the frequency dependence is stronger for the array with the perforated dielectric surface. Numerical results show that increasing the thickness of the perforated surface and reducing the diameter of its holes shifts the resonance of the surface waves from the normal to the array, although the reflection coefficient increases in this case.

UDC 681.325.5-181.4:656.2

### Interfacing Microprocessor-Controlled Railroad Systems With Outdoor Objects

917K0136A Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 12,  
Dec 90 pp 14-17

[Article by O. K. Dreyman, D. V. Gavzov, M. V. Ilyukhin, Leningrad Railroad Engineers Institute]

[Abstract] The issues of ensuring safety when using microprocessor- and microcomputer-based railroad traffic control systems (UVK) are addressed. The principal requirements imposed on interfaces (USO) through which all data from outdoor objects enter the computer are outlined. Diagnostic programs and functional diagnostics of interfaces are summarized and interface failures and their causes are described. The design of interfaces executed as function generators is described and principal trends in function generator-based interface development are presented. Several operating principles of actuator relays used in interfaces are described. The following interface design criteria are formulated: ensuring continuous serviceability of electronic elements by periodically changing their state (dynamic operation monitoring principle); statistical processing of actuator relay operation signals; galvanic input-output circuit isolation; frequency or amplitude circuit protection from power supply failures; absence of positive feedback leading to self-excitation; and phase or frequency protection from input signal distortions. Actuator relay control devices were checked experimentally in various electronic systems. Figures 8.

### Optimization Criterial of Railroad Telegraph Communication Network

917K0136B Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 12,  
Dec 90 pp 17-19

[Article by I. P. Barash, I. A. Zdorovtsov, P. F. Polyakov, Yu. N. Tereshchenko, Kharkov Railroad Engineers Institute]

[Abstract] Technical, economic, and social indicators characterizing railroad telegraph communication networks are summarized and communication network reliability factors are outlined. A comprehensive criterion, i.e., general efficiency, is introduced for estimating complex systems. In these estimates, technical, economic, and social criteria are taken into account as "weighted" valuating coefficients. Since this criterion cannot be used for evaluating and optimizing a network due to its complexity, groups of partial criteria are used instead in practical applications. Various methods of evaluating the designs of telegraph networks are outlined and the principal indicators used in selecting the network design version are described. It is shown that the use of integrated indicators makes it possible to select

the optimum version of a railroad telegraph network allowing for performance and socioeconomic quality indicators.

### Fault Location in Signaling, Interlocking, and Blocking Devices

917K0136C Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 12,  
Dec 90 pp 25-28

[Article by A. V. Grinenko, V. L. Labetskiy, Leningrad Railroad Engineers Institute]

[Abstract] Technical diagnostic characteristics of railroad automation and remote control systems (SZhAT) which contain mechanical, electrical, and electromechanical devices are outlined. Since SZhAT contain a large number of elements and are equipped with built-in diagnostic devices, they do not lend themselves to using any diagnostic method known from the reliability theory due to the considerable amount of time involved in locating faults. Various traditional diagnostic methods are summarized. Special attention is focused on the information method. Procedures for using diagnostic flow charts in locating open circuit-type stable faults which are the most common in practice are described using the example of an interlocked track switch with a two-wire switch drive control circuit with a PS-220M unit without a timer. Procedures for designing information fault location diagrams are described. Figures 9.

### Test Bench For Checking Signaling, Interlocking, and Blocking Devices

917K0136D Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 12,  
Dec 90 pp 29-33

[Article by A. Ya. Kushnarev, A. S. Malysh, Daugavpils Division of the Baltic Railroad]

[Abstract] A test bench for checking electric and time parameters of signaling, interlocking, and blocking system (STSb) instruments developed at the repair and maintenance administration of the Daugavpils Division of the Baltic Railroad is described. The device consists of instruments, a lighting screen, an electronic stopwatch, a timer, switches, control buttons, and jacks for switching instruments and circuits. The operation of individual components and the range of parameters checked by the device are outlined in detail. Conditions for measuring the time parameters of relays and track transmitters and the test bench operation in other measurement modes are described. The operation of the test bench itself, especially its electronic circuits, is monitored in the self-check mode. The functional diagram of the device is cited and its component diodes, transistors, displays, integrated circuits, and relays are listed. Figures 2; tables 1.

UDC 621.31 (091)

**Leningrad Cable System***917K011A Moscow ELEKTRICHESKIYE STANTSII  
in Russian No 12, Dec 90 pp 62-66*

[Article by A. I. Kuzmin, A. P. Shcheglov]

[Abstract] The development of the Leningrad electric power cable system since the adoption of the All-Russia State Electrification Program 70 years ago is summarized. Various protection devices used in 6-10 kV cables and automatic voltage regulators are described. Efforts to develop new cable fault location and diagnostic methods are noted. The combined length of power cables and the number of distribution panels and substations in the city in 1980 and 1990 as well as their percentage increase are summarized. The cable system layout in 1932 and types of 110 kV cable system applications at the present time are presented. New computerized remote monitoring and remote control systems are described and system optimization programs are outlined. The need to increase electric power supply reliability in the city is identified. Figures 2.

UDC 621.31

**Certain Ways of Increasing the Development Efficiency of Soviet Power Industry Under New Economic Conditions***917K011B Moscow ELEKTRICHESKIYE STANTSII  
in Russian No 12, Dec 90 pp 67-68*

[Article by N. F. Gorev, USSR Energy Ministry]

[Abstract] Obstacles to the development of the power industry posed by the environmental lobby and efforts to ban construction of hydroelectric and nuclear power plants are discussed. Fears that local councils will object to building and operating fossil fuel power plants in the territories under their jurisdiction are expressed. Promising and pragmatic approaches to bringing on stream new power sources most efficiently and cheaply are

proposed. It is suggested that specific measures be taken instead of wasting the effort on finding the culprits and causes of current problems. The conclusion is drawn that new outlays are feasible only if the resulting additional capacity calls for a capital expenditure of no more than one-half of the cost of obtaining the same capacity by construction. It is also suggested that the problem of increasing the efficiency of providing power to the national economy be solved by adding new gas turbines to existing boiler rooms; the suggestion is illustrated by an economic analysis. Ways of decreasing the specific fuel consumption for generating electric energy are described.

UDC 621.31:336.76

**Power Industry in Regulated Market Economy: A Discussion***917K011C Moscow ELEKTRICHESKIYE STANTSII  
in Russian No 12, Dec 90 pp 69-71*

[Article by M. N. Khodzhayev, Scientific Research Institute of Power Industry Economics]

[Abstract] The monopolized and centralized nature of the power industry and the rigidity and inflexibility of the existing economic arrangement in the USSR are acknowledged. The concept of market economy is outlined and its relevance to the power industry is addressed. The readiness of the power industry to switch to new operating conditions characterized by a scarcity of generating capacities, fuel, equipment, and materials is discussed. Available experience of switching to a market economy both in the USSR and abroad and power industry operation under such conditions are analyzed. The issue of property ownership relevant to the industry is addressed. It is suggested that parts of the power industry be transferred to republic and community control while the responsibility for the state and operation of industry facilities be placed on local authorities. It is shown that implementation of the measures outlined by the author would make it possible to prepare the power industry for operation in a regulated market economy.

**Modeling of Relations Within Small Groups and  
an Investigation of Negative Manifestations of the  
Human Factor in Management Processes**

917K0071A Kiev ELEKTRONNOYE  
MODELIROVANIYE in Russian Vol 12 No 3,  
May-Jun 90 pp 88-93

[Article by Yu. M. Gorskiy]

[Abstract] Various manifestations of the human factor in management and control processes are modeled in order to better understand management in small groups

and existing negative relations between the subsystems of a large system. Homeostasis and homeostatic control structures are used as the basis for the analysis. A block diagram of a simulation model that reflects the primary modes and "pathological" disruptions in critical control is given. The sixty possible combinations of relations, each with its own mathematical description and specific properties, are analyzed. Approaches to modeling relations in small groups are examined. The nature of transient processes that occur with different "pathological" shifts in critical control is discussed.

UDC 621.316.925.4

**Automatic Serviceability Check of Comprehensive Generator Protection**

917K0127A Minsk *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA*  
in Russian No 12, Dec 90 pp 24-29

[Article by L. F. Borisov, V. N. Bochkarev, V. Ye. Polyakov, All-Union Scientific Research and Exploratory Design Institute of Relay Technology and Urals Polytechnic Institute imeni S. M. Kirov]

[Abstract] Comprehensive multifunction generator protection (KZG) based on analog-to-digital converters and their parameters and circuit designs are summarized. KZG are tentatively divided into three parts: transducers, logic devices, and actuators. The composition of all three protection components is described. A mathematical model of KZG and a technique for determining their readiness for operation are proposed. Functional check procedures and the monitoring and signaling unit for this purpose are described. The logic unit is executed either on the basis of individual chips (IMS) or microprocessors. The principal purpose of KZG is to provide current protection with nonlinear operation characteristic. It is shown that the proposed mathematical model and readiness evaluation technique make it possible to establish the optimal interval for checking the KZG serviceability. The technique may be used to analyze the reliability of individual protection systems covered by periodic serviceability checks. References 7; figures 3; tables 1.

UDC 621.315.211.3

**Parameter Optimization of Oil-Filled Low-Pressure Cable Lines Using Complex Criterion**

917K0127B Minsk *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA*  
in Russian No 12, Dec 90 pp 54-56

[Article by E. N. Zuyev, P. A. Merkulov, Moscow Energy Institute]

[Abstract] Two optimization criteria used for 110-220 kV oil-filled (MN), low-pressure (ND) cable lines (KL) frequently used in urban high-voltage power systems - the maximum continuous cable load and the maximum economic efficiency, i.e., a minimum of adjusted fixed and variable costs of a 1 km line - are outlined. It is suggested that minimal specific adjusted outlays, i.e., the ratio of total adjusted outlays to the line's power transmission capacity, be used as the complex optimization criterion necessary for determining optimal technical and economic indicators of cable lines. An analysis of research data makes it possible to establish the most economically expedient ratio of electric insulation and

conductor radii for existing cost indicators under averaged cable laying and operation conditions. It is shown that the most feasible way of increasing the power transmission capacity of cables is to increase the conduction section to over 900 mm<sup>2</sup>. It is expected that this will result in a greater economic effect than measures aimed at decreasing the electric insulation thickness. References 2; figures 2.

UDC 621.315.613:621.81

**Improving Commutator Mica Insulation**

917K0127C Minsk *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA*  
in Russian No 12, Dec 90 pp 56-59

[Article by I. V. Kochugova, Leningrad State Engineering University]

[Abstract] Commutator mica insulation made from natural phlogopite mica with a novolac epoxy resin binder (ENS) made from SF-OCAA phenol formaldehyde resin and UP-612 cycloaliphatic epoxy resin is examined. The main requirement imposed on commutator insulation - minimal shrinkage during operation so as to ensure commutator integrity - is met due to the complete binder setting during the manufacturing. The total current method based on the proportionality of admittance to the functional group concentration is used to examine the ENS setting. An analysis of experimental data makes it possible to draw the conclusion that the ENS setting mechanism is determined by temperature. It is shown that ENS setting starts at a temperature of 105°C. Temperature conditions are recommended for making ENS-based commutator mica insulation. References 3; figures 3; tables 1.

UDC 621.316:621.854

**Extraction of Intelligence Signals on Cable Line Fault Location Using Coaxial Differential Magnetic Transducers**

917K0144A Novocherkassk *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA* in Russian No 11, Nov 90 pp 31-36

[Article by V. V. Platonov, V. F. Bykadorov, A. A. Pirozhnik, A. M. Klimentyev]

[Abstract] The ratios of legitimate/interfering signal developed over a damaged cable power line with a shorted conductor and measured by a coaxial differential magnetic transducer are examined. The transducer consists of outer and inner induction coils, active filters, a phase shifter, a summing amplifier, an electromechanical filter, and output amplifier, and a display with a telephone. The possibility of additionally compensating for the noise signal and selecting the legitimate signal over the cable line axis within 0.4-0.5 m is shown. The

functional diagram and technique for locating sheathing faults using coaxial differential magnetic transducers are given. Compared to a known single pickup coil, the legitimate signal selectivity of the above system of two differentially connected coaxial plane coils with different diameters is higher by an order of magnitude. References 2; figures 4.

UDC 621.3.087.92

### **Microprocessor-Based Transducers For Power System Emergency Control Equipment**

*917K0144B Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 11, Nov 90 pp 54-57*

[Article by A.-S. S. Saukhatas [as transliterated]]

[Abstract] Automatic emergency response devices (UPA) perform important functions in ensuring uninterrupted power supply. Today's microprocessor elements make it possible to combine the functions of numerous transducers in one device. A microprocessor-based circuit which makes it possible to select the parameters of three-phase current and voltage necessary for generating the control action in automatic emergency response devices of power systems is described. These devices prevent and eliminate asynchronous conditions in power lines and provide protection from overvoltage and overloads, locate disconnections, locate faults, and synchronize power systems. The hardware block diagram and software are presented and an electrodynamic model for testing the system is described. Laboratory tests using the electrodynamic model demonstrated good serviceability of the microprocessor system and its software. An analysis of functioning algorithms of complex electric power installation protection systems confirms the feasibility of their implementation on the basis of the structure described in the article. References 2; figures 2.

UDC 621.316.925.45

### **Digital Current Relays With Signal Waveform Recovery**

*917K0144C Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 11, Nov 90 pp 57-62*

[Article by E. V. Podgornyy, A. P. Mally, M. G. Lint, Ye. A. Kand rashova, A. Yu. Nikulichev, R. A. Sukhorukov]

[Abstract] Two problems must be solved in designing high-speed pickups for relay protection: tune out the free

components determined by processes in the power system and take into account the distortions added by instrument transformers, particularly current transformers (TT); these problems have been usually solved using nonsaturating transformers and frequency filters. Both problems are solved algorithmically. The issues of constructing simulation software for examining the processes in a zero phase-sequence current relay are considered. A technique is developed for examining a digital current relay; it includes a relay adjustment stage, an operation error calculation, and a response speed analysis. Simulation software test results are cited. It is shown that by compensating for the relay operation delay time due to intrinsic transient processes in frequency filters, one can design a current measuring pickup with an operation speed on the order of 10 ms. It is also shown that in recovering TT secondary current using "reciprocal" transformer models, the order of integrating formulas must be not lower than three. The method is suitable only for nonsaturating (TPY) TT. References 3: 2 Russian, 1 Western; figures 2; tables 3.

UDC 621.317.003

### **New Design of Two-Circuit Reinforced Concrete H-Frame Support**

*917K0126A Moscow ENERGETICHESKOYE STROITELSTVO in Russian No 11, Nov 90 pp 56-59*

[Article by F. I. Chebotar, R. M. Situdikov]

[Abstract] Optimization criteria of aerial power line (VL) supports are summarized. A new tangent suspension support SPB-110-2M design developed for the second stage of the self-compensating 100 kV Beltsy-Bilicheny aerial power line (SVL) in Moldova is described. All three adjacent phases are located in a horizontal plane. This reinforced concrete two-circuit support was designed by the Northwestern Department (SZO) of the Energosetproekt in cooperation with the Power Cybernetics Department of the Moldovan Academy of Sciences for use in wire icing regions III with a maximum velocity head of 500 Pa. It is intended for stringing six phases of AS-150/24 or AS-185/24 wires and two S-50 overhead ground wire cables. Support specifications and performance data are cited. The supports were tested mechanically. Static tests were carried out for four design conditions: normal wind, normal icing, emergency open circuit, and emergency open overhead ground wire. Design test load diagrams and test results are presented. Test results demonstrate that SPB-110-2M supports meet design specifications for principal design operating conditions and make it possible to recommend SPB-110-2M supports for use as tangent suspension supports for 110 kV SVL. References 1; figures 2; tables 2.

UDC 621.315.17

**Open Profile Piling Foundations For Installation in Permafrost Soil**

917K0126B Moscow ENERGETICHESKOYE STROITELSTVO in Russian No 11, Nov 90 pp 59-61

[Article by V. P. Yermakov, S. I. Zanyatin, A. L. Lyazgin, S. V. Ostroborodov]

[Abstract] An analysis of power line support failures in the north of the Tyumen oblast reveals signs of permafrost soil degradation around tubular pile foundations of aerial power lines (VL). One of the principal causes of this degradation is the water which fills the inner space of the tubular pile. The new exploratory research and design lab of the Energosetproyekt developed the design of a sectional cross-shaped open-profile pile made from two metal angles welded along the edges (along their entire length) or two mutually perpendicular metal plates of equal dimensions. In contrast to tubular piles, this pile has the maximum congelation surface since all of its sides along the perimeter come into contact with the surrounding soil which picks up the load from the pile. As a result, the load-bearing capacity of the open-profile pile under identical engineering and geological conditions is considerably higher than that of a tubular pile given the same geometric dimensions and specific quantity of metal per structure. The pile design is presented and its installation in permafrost soil is described. Pile test results show that the maximum stress in the piles does not exceed permissible levels while the load-bearing capacity exceeds specifications by twofold. The results also confirm the possibility of using open profile piles as transmission line support foundations in areas with permafrost soil. Figures 5; tables 1.

**Future Outlook of Elektrobank**

917K0126C Moscow ENERGETICHESKOYE STROITELSTVO in Russian No 11, Nov 90 pp 78-79

[Article by Ye. A. Minasbekov]

[Abstract] A shareholders meeting of the Elektrobank, an industry-wide commercial bank, was held in Sverdlovsk on 17-19 October 1990. The creation of such a financial institution was necessitated by the problem of ensuring stable operation of enterprises in a market economy and the development of an efficient financial system aimed at specific features of the industry; the new commercial bank is called upon to become the basis of this system. The bank will provide a full range of services, including lending, leasing, accounting, factoring, demand deposits, commercial insurance, and export-import operations in foreign currency. The Moscow-based bank will have an extensive network of branches throughout the country. It will be capitalized by shareholder contributions. Branches will be economically self-sufficient and their relationship with the parent bank will be formed on a contractual commercial basis. The principal difference between the Elektrobank and other commercial banks is

that its operating profits (i.e., generated by enterprises of the USSR Energy Ministry) will be invested back in the power industry.

UDC 621.31:338.4

**Basic Issues of Electric Power Industry Control Under Economic Independence of Republics and Regions**

917K0119A Moscow ELEKTRICHESKIYE STANTSII in Russian No 11, Nov 90 pp 2-6

[Article by Ye. Ye. Barykin, L. D. Khabachev, M. A. Chernin, Leningrad Regional Power Directorate and Northwestern Department of the All-Union State Exploratory Design and Scientific Research Institute of Power Systems and Power Grids]

[Abstract] Two issues raised in *Elektricheskiye stantsii* No. 11, 1989 by A. I. Baranovskiy - electric power rates and control of the power generation development - are discussed from the viewpoint of correlating power generation with regional *khozraschet*. The following conclusions are drawn by the authors: during the transition to a market economy, electric rates must be set and approved in a centralized fashion and may be uniform throughout the country or vary from region to region; in any case, the rates must ensure the necessary level of power generation profitability for each power engineering and electrification production association (POEE) and the industry as a whole; the pricing for energy transfers among POEE's must be based on the principle of complete cost recovery by the supplying grid; and in order to correct existing problems in the power industry, it is necessary to place the responsibility for supplying power to consumers on appropriate regional control bodies; in so doing, it is necessary to develop in each region specialized power generation development programs and submit them for consideration to Councils of Peoples Deputies at proper levels. References 1.

UDC [621.311.25:621.039].004.5(-87)

**Principal Directions and Development Trends of Nuclear Power Plant Diagnostic Systems**

917K0119B Moscow ELEKTRICHESKIYE STANTSII in Russian No 11, Nov 90 pp 11-20

[Article by A. I. Trofimov, A. K. Brovtsyn, Obninsk Nuclear Power Engineering Institute]

[Abstract] The need for more fully ensuring the reliability and safety of nuclear power plants by developing and broadly implementing engineering diagnostics systems (STD) and introducing improved automated control and diagnostics systems is discussed. Seven stages of STD development since the emergence of early systems are summarized. The recent Integrated Protection and Control Systems which are characterized by multiple redundancy of the main control channels, the self-diagnostics of both hardware and software, and the use of fiber optics are described. The organizations engaged in research in the field of nuclear power plant diagnostic systems in the USSR are cited. PWR and BWR reactor

failure statistics in the United States are summarized. Characteristics of various on-line and periodic diagnostic systems in the USSR and abroad are described. The experience of diagnostic system operation both in the USSR and abroad is analyzed. It is shown that despite the labor intensive and expensive nature of the measures, implementation of diagnostic systems not only helps to increase safety and improve environmental conditions but has a potential of becoming economically profitable in nuclear power plant operation. References 21: 9 Russian, 12 Western; figures 4; tables 4.

UDC 621.183:621.791.92.001.42

### Vacuum Furnace Deposition and Plating of Control and Stop Valve Parts

917K0119C Moscow ELEKTRICHESKIYE STANTSII in Russian No 11, Nov 90 pp 25-28

[Article by A. V. Orlov, Yu. N. Kriger, N. A. Chertkov, M. M. Klimochkin, Central Scientific Research Institute of Mechanical Engineering]

[Abstract] Existing methods of manual and automatic valve plating using welding technologies and surfacing in a furnace are summarized. The valve part plating with corrosion-resistant powder chromium-nickel compositions in a vacuum furnace with subsequent cooling is described. It is shown that heating in commercial vacuum furnaces makes it possible to surface batches of valves for various purposes and that vacuum deposition of chromium-nickel powders makes it possible to obtain high-quality seals with requisite hardness and mechanical properties; the development of iron-chromium-nickel-silicon solid solutions on the surfacing zone interface ensures a strong bond between the seal and the base material. It is demonstrated that application of protective coats by plating in a vacuum may be used in industry for treating the hidden outer and inner segments of valve parts; coats developed by chromium-nickel powders are 30-50  $\mu\text{m}$  thick and are sufficiently strong. References 4; figures 5.

UDC 621.311.24.003.1

### Economically Feasible Capital Investments in Wind Power Plants

917K0119D Moscow ELEKTRICHESKIYE STANTSII in Russian No 11, Nov 90 pp 67-68

[Article by V. S. Sharygin, A. V. Fomin, Northwestern Department of the All-Union State Exploratory Design and Scientific Research Institute of Power Systems and Power Grids]

[Abstract] The issue of computing economically feasible investments for making the operation of wind power plants profitable in the country's power grids at early development stages when performance indicators of such power plants are unknown is addressed. It is shown

that given different possible methodological approaches to determining the power substituted by windmill plants in the system, it varies from 10 to 40 percent of the plant's installed capacity; by controlling the wind power plant's energy yield according to the power system demand using the reservoirs of existing hydroelectric plants, the windmill's efficiency can be increased by 55-70 percent; under today's conditions, feasible capital investments into a wind power plant under study vary within 360-710 rubles per 1 kW depending on the methodological approach to estimating the wind power plant substitution power and allowing for the possibilities of controlling its power yield with the help of hydroelectric plant reservoirs. References 3; tables 1.

UDC [621.313:62-752].001.4

### Development of Electric Motors and Generators With Reduced Vibration and Noise Levels

917K0117A Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 90 pp 3-6

[Article by V. T. Medvedev, V. S. Malyshev, N. F. Tityukhin, Moscow Power Engineering Institute]

[Abstract] Various methods of decreasing the noise and vibrations of electric generators and motors (EM) and related electromechanical, elasticity theory, acoustics, electrical engineering, signal analysis, etc., tasks are considered. The cooperation between the Moscow Power Engineering Institute and CAD/CAM manufacturers and users as well as research organizations aimed at analyzing these issues are described. Structural and functional mathematical models developed as a result of such cooperation are summarized. The boundary elements method (MGE) which is efficient in solving applied problems of the elasticity theory and, consequently, is quite useful in analyzing deformations in EM's while reducing the geometrical dimension of the problem is described in detail. The EM housing behavior is described by the laws of elasticity theory and mechanics of deformable bodies. A comparison of analytical and experimental data demonstrates that theoretical results are consistent with experimental data thus confirming the expediency of using the MGE in designing EM's with a reduced noise and vibration level. Figures 1.

UDC 621.311.6.001.5

### New Principles and Experience of Designing Industrial Power Supply Units

917K0117B Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 90 pp 26-30

[Article by O. G. Bulatov, V. D. Polyakov, A. I. Tsarenko, Moscow Power Engineering Institute]

[Abstract] Today, the electric power supplied by industrial AC mains must usually be converted to a form

convenient for consumption, i.e., DC with set parameters, pulsed electric energy, high-frequency AC energy, etc. Thus, an electric energy converter directly affects the energy characteristics of any process, especially the efficiency,  $\cos\phi$ , harmonic composition of the current, its skewness, etc. The output characteristics of energy converters must therefore meet the requirements determined by both static and dynamic parameters of the medium (or the load). General requirements imposed on industrial power supplies for various types of units are summarized and different types of energy converters developed for various industrial power supply units are described. Load current switching principles utilized in the method of measured power transfer to the load during the operating cycles is analyzed and the advantages of this method are illustrated. The design of new modular converters and their specific applications are described. References 6; figures 2.

UDC [621.318.43::538.945].016.4

### On the Possibility of Using Multiple-Winding Superconducting Magnetic Energy Storage Systems

917K0117C Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 90 pp 30-34

[Article by V. V. Andrianov (deceased), A. Yu. Arkhangelskiy, V. V. Zheltov, S. I. Kopylov, Moscow Power Engineering Institute]

[Abstract] The issue of optimizing superconducting windings - the main element of superconducting inductive integrators (SPIN) which store energy in the winding's magnetic field - are considered. Assertions that the conductor utilization efficiency is directly proportionate to the winding dimensions and that the energy density within the SPIN volume increases by almost tenfold if a solitary coil is substituted with a group of smaller solenoids are analyzed. It is shown that both statements are both correct and incorrect to the same extent unless the SPIN design conditions are specified. It is shown that the selection of both the winding's absolute dimensions and relative parameters (the ratio of the winding thickness and length to its radius) must be correlated with the conductor parameters. A technique capable of performing such a correlation in a convenient nondimensional frame of reference is proposed. A domain of parameters within which the winding can be expediently realized in the form of individual modules is identified. The analysis helped to formulate the area of efficient applications of multiwinding designs and their additional advantages. It is shown that a transition to the concept of multiwinding SPIN's sharply decreases design costs and the financial risk involved in developing large unique system since most of the problems can be solved during the single module design optimization stage. References 7: 6 Russian, 1 Western; figures 2.

UDC [629.78:621.311.3.001.4]

### Analyzing the Tasks of Improving Space Vehicle Electric Power Supply Systems

917K0117D Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 90 pp 56-58

[Article by A. B. Tokarev, Moscow Power Engineering Institute]

[Abstract] The requirement of increasing the efficiency and improving the performance of space vehicle (KA) electric power supply systems (SES) which necessitate both the optimization of operating conditions and structural and parametric optimization is considered. Since solar batteries (SB) and storage cells (AB) are the main electric power source for space vehicle power supply systems, issues dealing with the design of SES's which contain such elements are addressed. Systems, parametric, and performance problems which must be solved in designing these systems are summarized. The problems of synthesizing and analyzing designs and making the decision for selecting the optimum version as well as the mathematical models used for solving them are described. Parametric and performance optimization problems are cited. It is shown that efficient formulation and solution of general and particular systems problems of designing space vehicle power supply systems make it possible to reach optimal designs and improve the mass and overall dimensions of the systems. An experimental microcomputer-based CAD system for SES's and their elements being jointly developed by the MEI and other organizations is described. References 6; figures 1.

UDC 666.3.022.6.001.4

### Hot-Molded Ceramic Materials in Electrical Engineering

917K0117E Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 90 pp 75-78

[Article by A. N. Bibichev, A. V. Dolgov, S. A. Kamynina, Ye. A. Melnikov, V. A. Filikov, Moscow Power Engineering Institute]

[Abstract] Existing methods of fabricating ceramic products and their advantages and shortcomings are summarized. A relatively new method developed by the authors for synthesizing metal oxide ceramics for various functional purposes, i.e., the hot molding method which makes it possible to obtain a solid product from powdered raw materials and is largely capable of overcoming the difficulties inherent in traditional synthesis methods, is described. The advantages of the method and principal characteristics of the caking process are analyzed. A unit designed and manufactured by the authors for examining the hot molding of metal oxide ceramic materials is described. The principal parameters and characteristics of the hot-molding process are presented.

Ways of reducing superconductivity degradation in high- $T_c$  ceramics are addressed. It is shown that hot molding makes it possible to produce metal oxide ceramics with a close-to-ideal density and perfect microstructure. A high- $T_c$  material whose parameters are not susceptible to degradation during a long time and high-capacity varistor ceramics with a high degree of microstructural homogeneity have been synthesized. References 10: 6 Russian, 4 Western; figures 4; tables 1.

UDC 697.34.313

### Prospects for Heating Supplies in Kiev Through the Year 2000

917K0118A Kiev ENERGETIKA I  
*ELEKTRIFIKATSIYA* in Russian No 4, Oct-Dec 90  
pp 17-19

[Article by O. P. Zelenyak, O. P. Zuev, F. Ya. Ioffe, M. G. Manelis]

[Abstract] The future prospects for heating supplies in the city of Kiev through the year 2000 are reviewed. Existing heating capacity (number of production facilities; total thermal power output; average thermal power output, etc.) is considered. A breakdown of current production capacity (industrial and heating boilers, furnace and gas columns, and power and heating generating plants) is also given. It is determined that up to 50

of the municipal heating capacity is provided by small, low-efficiency boilers. In order to improve reliability and efficiency of municipal thermal power output, a number of new thermal production sources are proposed such as 1,000 megawatt TETs-7 power and heating generating plants and approximately 200 kilometers of new thermal power distribution lines.

UDC 621.311

### Improving the Testing Reliability of Fuses

917K0118B Kiev ENERGETIKA I  
*ELEKTRIFIKATSIYA* in Russian No 4, Oct-Dec 90  
pp 32-33

[Article by V.V. Kozyrskiy, A.V. Kravets]

[Abstract] A fuse testing device is proposed for improving the reliability of fuse operation. The device consists of a high-voltage fuse, a spring, an activation indicator, a permanent magnet, a barrier, a cap and a sealed-reed relay along with an indicator. The device has superior reliability and safety. The unit can find broad applications in electric power plants using fuses on 10/0.4 kilovolt transformer substations. The device can also be used in VNP-17 load switches.

UDC 338.45:621.31

### Forecasting of Regional Power Production Capacity

917K0118C Kiev ENERGETIKA I  
*ELEKTRIFIKATSIYA* in Russian No 4, Oct-Dec 90  
pp 34-37

[Article by Yu.G. Blavdzevich, S.K. Komova]

[Abstract] A factor-based method of forecasting regional power production capacity for the upper management levels (national economy, branch, ministry and union) is proposed. A chain factor substitution method is used. A breakdown of regional power production capacity among industry, construction, transport, agriculture and domestic consumption is given. An algorithm is developed for implementing this forecasting method. The forecasting method involves varying such factors as the fraction of industry and other fields of the national economy involved in the total power production as well as the rate of growth (reduction) in power generating capacity in industry, agriculture, transport, agriculture and other fields. The use of the method makes it possible to account for and estimate the effect of variable factors on the change in power production capacity. The algorithm can be run on personal computers for multivariate calculations with variable input data.

UDC 621.16

### Optimization of Energy Consumption by Industrial Enterprises

917K0118D Kiev ENERGETIKA I  
*ELEKTRIFIKATSIYA* in Russian No 4, Oct-Dec 90  
pp 39-41

[Article by B. G. Tuvalbaev, Ye. M. Marchenko, V. G. Karpov]

[Abstract] A number of new approaches for improving electrical and thermal power consumption conditions and determining the maximum cost-effectiveness of energy-saving measures are considered. It is determined that the reduction in energy consumption per unit of production achieved by energy-saving measures follows a near-exponential law as well as other nonlinear, continuous and monotonic relations. The approach developed here has an advantage over traditional methods of determining costs of energy saving measures in that it outlines specific recommendations for determining an efficient level of investment in energy-saving measures. Such recommendations include specific selection of an optimum energy carrier, optimum energy supply networks and optimization of energy distribution conditions.

UDC 621.47

**The SPG-28-40 Solar-Powered Steam Generator in Experimental Operation**

917K0118E Kiev ENERGETIKA I  
*ELEKTRIFIKATSIYA* in Russian No 4, Oct-Dec 90  
 pp 42-43

[Article by P. F. Zeytulaev]

[Abstract] Ongoing operations to bring the SPG-28-40 solar-powered steam generator on-line at the SES-5 Crimea experimental solar-power electrical generating plant are reported. The SPG-28- 40 has an open-air polygonal configuration of sixteen tubular vertical solar power panels seven meters in diameter mounted on a 66-83 meter support tower. The steam produced by the generator has a high moisture content, which is confirmed by a high water level in the heat accumulator. It was therefore determined that the unit is has poor water vapor separation. It is recommended that the steam distribution plate be disassembled and that a minus 70 millimeter water level be maintained in the drum as a temporary measure for improving water vapor separation in order to reduce steam humidity.

UDC 621.31:378:061.5

**Training Cadres of Engineers and Scientists in Department of Electric Power at Moscow Institute of Energetics: Status and Problems**

917K0081A Moscow ELEKTRICHESKIYE STANTSII  
 in Russian No 10, Oct 90 pp 5-7

[Article by B. K. Maksimov, doctor of technical sciences, dean, Department of Electric Power, Moscow Institute of Energetics]

[Abstract] Following establishment of the Moscow Institute of Energetics in 1930, its Department of Electric Power was organized in 1932 and then became one of the oldest one to train first-rate specialists in this field. Credit for upholding its tradition of excellence goes to Professors A.A. Glazunov, L.I. Sirotinskiy, S.A. Lebedev, P.S. Zhdanov, A.Ya. Rybkov, A.M. Fedoseyev, V.A. Venikov, and D.V. Razeviv on the faculty staff, also to visiting lecturers including Professors S.A. Ulyanov, I.A. Syromyatnikov, P.G. Grudinskiy, I.I. Solov'yev, N.A. Melnikov, and L.A. Zhukov. In the area of scientific research this department is successfully involved in development of new methods of transmitting electric energy, in problems of controlling complex modes of electric power system operation, including protective relaying and automation, in formulation and development of a scientific approach to reliable electric power plant, network, and system operation, in development of interactive information subsystems and of training systems for technical personnel, in optimizing the design of insulation systems for extra-high and

ultrahigh voltages, in problems of electromagnetic compatibility, and in development of methods along with instrumentation for diagnostic testing of electric apparatus. Noteworthy among recent developments are up-to-date procedures and software for steady- state, transient, and stability analysis of electric power plants equipped with modern control systems, new methods of regulating the excitation of variable-structure synchronous machines without causing oscillations in interconnected power systems, and theoretically sound methods for stability analysis and global performance analysis of highly complex power systems such as the USSR Unified Power System to be completed by the year 2010. Other achievements include methods of analyzing three-dimensional magnetic structures with nonlinear ferromagnetic components of intricate shapes, improvement of the eddy-current method for inspection and diagnostic testing of multilayer ferromagnetic current conductors. An important project underway is development of a computer-aided design system, to be used for construction of new hydroelectric and solar electric power plants. The department has developed State Standards pertaining to short-circuit currents and electrodynamic stability, some of these standards having already put into effect. The Institute has professional relations with foreign educational institutions and commercial relations with foreign firms. It is also a member of various international organizations and participates in international as well as in USSR national exhibitions.

UDC 621.22:378

**Hydraulic Engineers at Moscow Institute of Energetics Managing Nation's Energy Resources**

917K0081B Moscow ELEKTRICHESKIYE STANTSII  
 in Russian No 10, Oct 90 pp 8-11

[Article by V. I. Obrezkov, doctor of technical sciences, Moscow Institute of Energetics]

[Abstract] After hydraulic power engineering had been taught at the Moscow Institute of Energetics as a specialty course since 1933 in the Department of Hydraulics and Hydraulic Power Engineering, a separate Chair of Hydraulic Power Engineering was established in 1945 and since then graduated cadres of specialists in hydroelectric power plants: over 1500 hydraulic power engineers over the 1949-1990 period. To conform with the trends in the national economy and the attendant expansion of research activity, the name was in 1988 appropriately changed to Chair of Hydraulic Power Engineering and Electrical Power Engineering of Renewable Energy Sources. The research activity concerning optimization of power plant performance and control has since then acquired a new dimension, owing to development and introduction of a computer-aided design system consisting of several subsystems. One of the subsystems, namely selection of basic power equipment, is particularly relevant to design optimization of hydroelectric turbogenerators with respect to ecological as well

as technical and economic criteria. Weekly load cycles are now also taken into account in performance analysis of pumped-storage hydroelectric power plants operating with nuclear power plants for adequate coverage of base and peak loads. The design system covers small as well as large hydroelectric power plants, the control system being now in each case designed on a multicriteria basis. Another target of research activity and instruction at the Department of Hydraulics and Hydraulic Power Engineering is optimum utilization of water resources, especially in power plant compounds. An automatic data acquisition and processing system has been built for this purpose, also for operation analysis of the entire power apparatus in a power plant. It operates with a CAMAC crate in the interactive mode and, on the basis of continuous data input and statistical analysis, facilitates monitoring the state of not only individual power system components but also of a power system as a whole. Research is being extended to design, performance, and cost analysis of solar electric and wind electric power plants according to similar criteria.

UDC 621.315.1:621.316.925.001.24

### **Impedance of Compensation in PDE-2003 Negative-Sequence Power Relay Protecting 330-750 kV Overhead Transmission Lines**

917K0081C Moscow ELEKTRICHESKIYE STANTSII  
in Russian No 10, Oct 90 pp 76-78

[Article by V.A. Gitman, engineer, and M.L. Zhidovetskiy, engineer, All-Union Planning-Surveying and Scientific Research Institute of Power Systems and Electrical Power Networks, Ukrainian branch]

[Abstract] The basic component of the PDE-2003 directional high-frequency differential-phase protective system for 330-750 kV overhead transmission lines is a negative-sequence power relay with two output circuits, a holding one and a tripping one. The current sensitivity of the latter can be improved by compensation of the negative-sequence voltage drop, this being necessary only in the case of an otherwise inadequate voltage sensitivity. The magnitude of the compensating impedance is determined by both sensitivity and selectivity criteria. It is calculated accordingly on the basis of a short-circuit analysis. Considering specifically near short-to-ground faults behind the station busbars, a procedure is outlined for correctly setting the impedance of negative-sequence voltage drop so as to prevent nonselective relay action. Figures 2.

UDC 621.315.615.2-69

### **Transformer Oil Heater**

917K0081D Moscow ELEKTRICHESKIYE STANTSII  
in Russian No 10, Oct 90 pp 88-91

[Article by N. K. Vasilyev, engineer, Yu. A. Fominykh, engineer, and V. A. Volkov, engineer, Ural Electrical

Apparatus Installation Works and Scientific Research Institute of Scientific-Industrial Association "Uralelektrotatyazhmas" (Ural Heavy Electrical Machine Construction)]

[Abstract] An electric 160 kW transformer oil heater which includes a filter for removal of mechanical impurities has been designed and built for operation from a 380 V 3-Φ power line with the capability of heating transformer oil at rates up to 25 m<sup>3</sup>/h to maximum permissible 85°C temperature (15°C heater-oil temperature difference at inlet, minimum outlet pressure 0.2 MPa). The heater consists of three coils of corrugated steel ribbon, one above the other, forming a column inside a cylindrical shell under a conical cover, mechanically separated by insulators and electrically connected into a wye. The shell with the heater column is mounted on insulators inside a weather-proof metal housing, a 1.19x1.25 m<sup>2</sup> wide and 1.79 m high welded structure, with three doors for the maintenance crew. Ancillary equipment inside the housing includes a suction pump with flow control, two thermometers with a relaying system each for automatic oil temperature regulation (manometer-thermometer) and heater temperature control (dilatometer-thermometer) respectively, and the oil filter on the inlet side. The heater was comprehensively tested on transformer oil entering at rates of 1.1-26 m<sup>3</sup>/h, the oil temperature at the inlet being varied over the 40-(-40)°C range in 10°C intervals. Heating a 5 m<sup>3</sup> volume of transformer oil entering at a rate of 25 m<sup>3</sup>/h from almost any temperature to 80° temperature does not take longer than half an hour. The heater is suitable for operation in the Far Northern regions. Figures 4.

UDC 621.315.62.001.5

### **Wet-Discharge Characteristics of Hollow Cylindrical Insulators**

917K0077A Moscow ELEKTROTEKHNIKA in Russian  
No 10, Oct 90 pp 2-7

[Article by G. N. Aleksandrov]

[Abstract] The internal rib shape of hollow insulators is optimized to enhance discharge characteristics. Models are developed for analyzing the discharge development mechanism on the inner insulator surface. The wet-discharge voltage of the insulators is found to be equal to the product of the peak current and the total resistance of the wet insulator surface. Optimum insulator diameters are compared, and the electrical characteristics of such insulators are examined. It is determined that the use of polymer rather than porcelain materials makes it possible to avoid fabrication constraints and improve performance and stable operational voltage levels.

UDC 621.316.937.002.2

**Prospects For the Development of a Unified Series of Electron Gas Overvoltage Limiters***917K0077B Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 90 pp 10-13*

[Article by V. A. Volkenau, V. K. Pugachev, S. Yu. Rogovenko]

[Abstract] Efforts to develop a unified series of electron gas overvoltage limiters for operation at 1150 kilovolts are reported. The designs employ an active section consisting of 33 elements separated by fiberglass rods suspended between a high-voltage insulator and the support insulators of the grounding terminal. The primary designs intended for integration into the series include the OPNe-1150, the OPNE-220 and the OPNE-500 overvoltage limiters. Calculations and tests on these devices confirm the possibility of integrating these overvoltage limiters into a unified series.

**Switching Capacity of High-Voltage Switches and Testing Methods***917K0077C Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 90 pp 19-23*

[Article by N.M. Chernyshev, L.G. Kattel, I.M. Butkevich]

[Abstract] The switching capacity of high-voltage switches is analyzed as possible use as a test parameter since both the switching current amplitude and the mechanical loading of the switch are determined by the switching arc energy. By controlling the phase switching angle, the switch load can be varied. Possible modifications of switching tests on high-voltage switches aimed at reducing the necessary number of tests and improving the value of the results are considered. Curves of the breakdown voltages under various applied voltage levels are given together with the relations between the maximum switching arc duration, the relative concentration of the aperiodic current component and the rate of variation in the breakdown voltage.

UDC 621.316.5:001.24

**Heat Liberation in Split Shielded Current-Carrying Systems***917K0077D Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 90 pp 73-76*

[Article by V. A. Petrushchenkov, P. V. Zhuravlev]

[Abstract] Thermal engineering calculation methods are developed for a simple split current-carrying system and a two element screen with a double-arc cross-sectional design. Heat is liberated in such systems by radiation and free convection. Equations are provided for determining the radiative heat exchange in a split shielded

current-carrying system. These equations are used in conjunction with experiments for criterional processing of freely-convective heat exchange of both individual and interacting shielded current-carrying systems. Optimum ranges of relative screen spacings that maximize heat convection are determined.

UDC 621.039.673

**Capacitor Bank for Pulse Generation in a Railgun***917K0078A Moscow ELEKTRICHESTVO in Russian No 10, Oct 90 pp 36-40*

[Article by A. V. Alekseev, A. M. Baltakhanov]

[Abstract] A procedure is developed for synthesizing the parameters of a capacitor bank designed to generate pulses for a railgun based on a given time dependence of the current level in the railgun. The capacitor bank fabricated for tests consists of individual capacitor modules controlled by primary and crowbar switches. The switches in each group of capacitor modules are activated simultaneously. The capacitor modules are connected to the railgun through current-carrying lines and shaping coils. A solution algorithm is developed for calculating capacitor bank parameters and optimizing the capacitor bank design for a given shape, load current values and design constraints. A difference method is used to solve differential equations describing the transient processes occurring in the bank. The parameters of the capacitor banks at various operating voltages are provided.

UDC 62-83-52

**Thyatron Electric Servo With Coordinate Computers Employing Motor Rotor Position Sensors***917K0078B Moscow ELEKTRICHESTVO in Russian No 10, Oct 90 pp 76-80*

[Article by M.A. Borovikov, V.I. Domanov, V.E. Nasatyrykin]

[Abstract] Electric servo drives with actuator thyatron motors are proposed. The rotor position sensors of these thyatron motors are used not only for controlling the phase currents of the armature windings but also for direct measurement of the electromagnetic moment and rotation frequency. A schematic of the servo drive employing the actuator thyatron motor is given. Schematics of the initial servo electric drive and a modified drive that permits measurement of the electromagnetic moment and rotation frequency are provided. Experimental tests on the servo electric drives employing DBM 185-6-0-4-2 motors yielded a positioning time of approximately 7 milliseconds for handling angular motions of one to two degrees with a position circuit bandpass of 70 Hertz.

UDC 621.317.7.082.742.001.6

### Electromagnetic Conduction Device

917K0123A Moscow ELEKTRICHESTVO in Russian  
No 9, Sep 90 pp 1-6

[Article by L. V. Pivovarov]

[Abstract] Design versions of an electromagnetic conduction device for transporting, throttling, or measuring the parameters of corrosive or toxic conducting media for various purposes with nonlinear characteristics, e.g., a temperature-sensitive resistor, are examined using integral characteristics; principal results of experiments with an operating model of the device are cited and certain problems related to the use of conduction devices in liquid electrolytic circuits with important theoretical and practical applications are formulated. It is shown that liquid technological MHD circuits are being increasingly used in the national economy and that electromagnetic conduction devices necessary for controlling and operating such circuits have obvious advantages, e.g., multifunction capability, design simplicity, reliability, and adaptability to streamlined manufacturing. References 8; figures 5.

UDC 621.319.4:621.315.612.027.3.029.5.001.24

### Thermoelastic Stresses and Heat Breakdown of the Second-Kind in High-Voltage High-Frequency Ceramic Capacitors

917K0123B Moscow ELEKTRICHESTVO in Russian  
No 9, Sep 90 pp 20-25

[Article by V. A. Gnezdyn, E. I. Yermolina, O. G. Kovalevskaya, I. T. Rozin, A. I. Semenova, Ye. V. Kharitonov]

[Abstract] The results of temperature field and thermoelastic stress analyses in high-voltage high-frequency ceramic disc and tubular capacitors as well as data of experimental failure test during the heat breakdown of the second kind are cited for various types of electrical loading. A cylinder and a hollow cylinder of finite dimensions are selected as the mathematical model of the disc and tubular capacitor, respectively. The model takes into account the possibility of heat breakdown of the second kind due to thermoelastic stress. In addition, a model of the ceramic capacitor's life relative to the heat breakdown of the second kind is constructed. The mechanism of the heat breakdown of the second kind is experimentally corroborated in ceramic capacitors. The resulting life model parameters make it possible to predict the capacitor's operating time under various loading and cooling conditions. References 8; figures 4.

UDC 621.311 (47 + 57) (73)

### Outlook For Consolidating U.S. and USSR Power Systems

917K0123C Moscow ELEKTRICHESTVO in Russian  
No 9, Sep 90 pp 25-28

[Article by V. V. Yershevich, Yu. L. Antimenko]

[Abstract] The outlook for integrating U.S. and USSR power systems is considered and possible advantages of such a consolidation are examined. It is shown that by integrating U.S. and USSR power systems we could lower the installed capacity demand by consolidating daily and annual load peaks, decreasing the system redundancy, increasing the guaranteed hydroelectric power plant output, etc. Moreover, it would improve the operating conditions of power plants and their ecological impact and decrease cost outlays for long international transmission lines due to the intersystem effect. Possible future construction of large nuclear, fossil fuel, or tidal power plants in Alaska and the northwestern part of the USSR will, in addition to ecological and cost advantages, bring closer together the main power grids of both countries and create favorable conditions for integration with possible inclusion of Canada and will reduce the necessary transmission line capacity by almost twofold. It is also shown that integrated lines could be developed using today's technology. References 2; figures 3; tables 1.

UDC 621.314.5

### Phase Control of Eight-Bit Microprocessor-Based Electronic Converters

917K0123D Moscow ELEKTRICHESTVO in Russian  
No 9, Sep 90 pp 51-57

[Article by Ye. Ye. Chaplygin]

[Abstract] Eight-bit microprocessors (MP) widely used for designing cheap built-in controllers with a broad range of components are considered in the light of the emergence and development of single-chip microcomputers which greatly improve the performance of built-in controllers. Design principles of phase control devices with eight-bit MP's, especially the K580M80A used in series 1816 microcomputers are examined. The possibilities of developing MP-based systems which are comparable to existing designs with respect to their accuracy and speed are analyzed and the task of minimizing hardware outlays for MP-based designs is addressed. The pulse-duration modulation method of phase control is used in the analysis and various types of coding are summarized. It is shown that the use of vertical control is consistent with the controller's multifunction capability and that in a number of systems the controller is capable of performing other functions, such as serving as regulators, control circuit protectors, and diagnostic devices. References 5; figures 3; tables 1.

UDC [621.315.6:537.533.75].001.24

**Energy Absorption Analysis of the Interaction of 0.001-10.0 MeV Electromagnetic Radiation With Electric Insulation Material**917K0123E Moscow ELEKTRICHESTVO in Russian  
No 9, Sep 90 pp 57-61

[Article by V. V. Maslov, O. Yu. Rtishcheva, A. A. Stroganov, All-Union Science Research Institute of Electric Insulation Materials]

[Abstract] Energy absorption by electric insulation materials under the effect of  $\gamma$ -radiation and the ensuing alternating generations of  $\gamma$ -quanta, electrons, positrons, etc., which form a cascade shower whose characteristics are almost impossible to calculate precisely, are examined. Mass absorption coefficients are calculated for various energy levels of  $\gamma$ -quanta and for the interaction of radiation with electric insulation materials, insulation systems, and inorganic fillers. Various methods of computing the absorbed  $\gamma$ -radiation energy are summarized and examples of calculating the energy absorbed by electric insulation materials using chemical dosimeters and on the basis of the known  $\gamma$ -quanta flux and isotopic source parameters are cited. References 11: 10 Russian, 1 Western; figures 1; tables 2.

UDC 621.311.016.3.001.24

**Supplying Energy Consumers With Sharply Varying Load From Electric Power Systems**917K0116A Moscow ELEKTRICHESTVO in Russian  
No 11, 1990 pp 1-6

[Article by V. A. Barinov, A. A. Gurov, V. Yu. Korchak, A. S. Manovich, Yu. V. Mitin]

[Abstract] The development of powerful energy sources for supplying electricity to various types of installations with a sharply varying cyclical load is considered. It is shown that the demand of such installations may be covered by controlling the kinetic energy of synchronous generator rotors and the demand of conventional energy users due to changes in the power grid's voltage and frequency when it picks up the load. It is also shown that if the load variation is cyclical, the main requirement is to eliminate resonance effects; this may be achieved by using various control devices, e.g., static reactive power equalizers, filtering compensating circuits, integrators, and energy absorbers or by improving rectifier valve designs and their control systems. It is further demonstrated that the perturbations affecting slowly varying loads in power systems may be compensated for by controlling primary generator motors and using statistic reactive power equalizers and filters. References 9: 6 Russian, 3 Western; figures 2; tables 2.

UDC 62-592.35.001.24

**Theoretical Aspects and Design of High-Torque Electromagnetic Brakes**917K0116B Moscow ELEKTRICHESTVO in Russian  
No 11, 1990 pp 25-30

[Article by V. M. Lupkin, All-Union Scientific Research Institute of Electric Motors]

[Abstract] An attempt is made to clarify the theory of electromagnetic brakes and provide an analytical solution of the equations of electromagnetic processes occurring in the brakes as well as analyze the factors which can be identified there. It is shown that the problem of calculating eddy currents in the moving armature of an electromagnetic brake may be solved on the basis of Maxwell's equations denoted in the moving armature's body axes system; that the Pointing-Umov vector flux which is transported by the mechanical motion of the body exists on the surface of a conducting body moving in a static magnetic field; that the tangential braking force on the armature surface may be calculated from the ponderomotive force expression, through the Maxwell voltage tensor, and by using the Pointing-Umov vector; and that to take into account considerable pole leakage flux in high-torque electromagnetic brakes, the magnetomotive force of the poles creating the leakage flux must be found from the real pattern of field penetration into the moving armature. The resulting solution makes it possible to take into account all basic features of high-torque brakes: the air gap, the magnetic permeability variability of the armature and field structure, and the latter's leakage flux. References 17; figures 3.

UDC 621.316.1.017.001.24

**Evaluating Electric Grid Power Losses on the Basis of Computational Experiment Results**917K0116C Moscow ELEKTRICHESTVO in Russian  
No 11, 1990 pp 55-59

[Article by A. A. Arutyunyan, Armenian Power Grid Design Institute]

[Abstract] The method of staging a computational experiment and using the resulting information to estimate the power consumption in electrical grids is presented. The network's consumption is estimated on the basis of the operating parameters of individual units (power supply centers) controlled by individual power system dispatchers or by using the grid's integral parameters. As a result of the study, an algorithm and a comprehensive program are developed for designing a computational experiment and plotting regression models for estimating the power demand in the power system's electric networks determined by both the housekeeping requirements and overflows into adjacent power systems. References 7; figures 1; tables 4.

UDC 62-784.64.001.24

**Mass Optimization of Combined Electromagnetic Screen**

917K0116D Moscow ELEKTRICHESTVO in Russian  
No 11, 1990 pp 62-65

[Article by B. I. Petlenko, A. Ye. Dergachev]

[Abstract] Combined electromagnetic screens which are used to shield sensitive microprocessor and microelectronic systems from the electromagnetic radiation generated by electrical equipment are examined. The optimum thickness of the screens' coating and ferromagnetic section which ensures complete attenuation of the electromagnetic wave with a minimal screen mass is determined allowing for the skin effect and substrate saturation; to this end, a computational model of the combined electromagnetic screen is developed. It is established that there exists an optimum thickness of a nonmagnetic conducting coating for combined electromagnetic screens and that it can be calculating using the proposed analytic expressions. References 6; figures 2.

UDC 621.318.1.013.001.24

**On Various Approaches to Calculating Volumetric Electromagnetic Force Density in Nonlinear Magnetic Systems**

917K0116E Moscow ELEKTRICHESTVO in Russian  
No 11, 1990 pp 74-75

[Article by Yu. V. Abramkin, Moscow Power Engineering Institute]

[Abstract] It is shown analytically that A. Nicolaide's statement in *Elektrichestvo* No. 5, 1990 that J. Maxwell's formula for volumetric electromagnetic force density in a static magnetic field becomes identical to the formula suggested by A. Einstein and I. Laub after a little manipulation is totally unfounded. It is demonstrated that no such transformation exists. References 3: 2 Russian, 1 Western.

UDC 621.318.1.013.001.24

**Author's Response**

917K0116F Moscow ELEKTRICHESTVO in Russian  
No 11, 1990 pp 76-87

[Article by Ye. L. Lvov]

[Abstract] A response to Abramkin's letter in *Elektrichestvo* No. 11, 1990. The physical laws which

underlie the formulas for the density of volumetric forces affecting a magnetic material with conduction currents in it and the corresponding formulas for the field tensors and strains caused by electromagnetic forces in ferromagnetic bodies are examined. It is shown that the objections against fundamental premises of classical electrodynamics with respect to Ampere's concept that a polarized medium is equivalent to a system of molecular currents and to Maxwell's expression of volumetric forces through the potential function gradient raised in the course of the discussion are unfounded. It is demonstrated that the examples which in the critics' opinion refute Ampere's model are accompanied by flawed calculations and do not corroborate their authors' statements. References 28; figures 6.

UDC 621.318.1.013.001.24.001.8

**Comparison of Maxwell's Formulas to Other Formulas For Calculating Electromagnetic Forces in Magnetic Field**

917K0116G Moscow ELEKTRICHESTVO in Russian  
No 11, 1990 pp 87-93

[Article by A. V. Ivanov-Smolenskiy]

[Abstract] Two methods offered by J. Maxwell on the basis of Lagrange's concepts for calculating the electromagnetic forces affecting a certain volume in magnetic field are summarized. It is emphasized that most of the methods used today to compute the electromagnetic forces in a magnetic field are based on the principles outlined in Maxwell's obscure 1861 treatise. It is shown that Maxwell's second formula for the volumetric density of electromagnetic forces is identical to Einstein's and Laube's formula. Both of Maxwell's formulas are compared to those derived by Lvov. The relevance of Ampere's model to Maxwell's and Lvov's concepts is discussed. The conclusion is drawn that Maxwell's first formulas are unique among known electromagnetic force density formulas in that they were derived by many different methods in the strictest possible way from Maxwell's mathematical model of magnetic field; that these are the only formulas for the electromagnetic force density which contain no errors in their derivation; and that these are the only formulas which extend to magnetically nonlinear bodies and make it possible to find the electromagnetic force, mechanical stresses, and strains in these bodies and are consistent with experimental data. References 17: 11 Russian, 6 Western; figures 7.

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